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ABSTRACT

This study attempts to reinforce developmental theory concerning spatial Comprehension by building on the qualitative observations of art educators of the past, and by strengthening the empirical basis of contemporary investigations into the relationship between pictorial representations, intellectual maturity, and environmental stimulation. Drawings from a wide variety of cultures were studied to determine whether the sequence and rate at which developmental characteristics appear are similar, or reflect unequal socioeconomic/educational opportunities and ethnic diversity within societies. Also investigated was whether differences between societies may correlate with modernity, prevalence of literacy, and severity of social stratification. A total of 9,000 drawings was collected from middle and lower class children in grades 1, 3, 5, and 7 in nine countries. Each child was asked to draw a picture of himself at play with friends near his home or school. Sorting categories were based on Piaget's description of stages in the development of the concept of space and the growth of logical thought. Results suggest that these drawing stages follow an invariant sequence. Mean ages, higher than expected, lie within a large range at each stage; the mode appears at the onset of concrete operations; and differences, when appearing, generally lie in the direction of higher scores for advantaged groups. (Author/SDH)

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Final Report

Project No. RO 2-0611
Grant No. OEG-0-72-4524

The Development of the Concept of Space as Observed in Children's Drawings: A Cross-National/Cross-Cultural Study

(Based on the theories of Jean Piaget)

Betsy Nan Hess-Behrens

Lawrence Hall of Science

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ABSTRACT

This study attempts to reinforce developmental theory concerning spatial comprehension by building upon the qualitative observations of art educators of the past, and by strengthening the empirical basis of contemporary investigations into the relationship between pictorial representations, intellectual maturity, and environmental stimulation.

Drawings from a wide variety of cultures were studied to determine whether the sequence and rate at which developmental characteristics appear are similar, or reflect unequal socio-economic/educational opportunities and ethnic diversity within societies; also whether differences between societies may correlate with modernity, prevalence of literacy, and severity of social stratification.

Drawings (following standardized instructions) were collected from middle and lower class boys and girls in nine countries--100 from each of grades 1, 3, 5, and 7 per group--approximately 800 per country (plus extra groups), for a total of 9,000 drawings.

Sorting categories were based on Piaget's description of stages in the development of the concept of space and the growth of logical thought.

Results suggest that these drawing stages follow an invariant sequence. Mean ages--higher than expected--lie within a large range at each stage; the mode appears at the onset of concrete operations; and differences, when appearing, generally lie in the direction of higher scores for advantaged groups.

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PREFACE

Since this study originated at the University of Chicago in 1966, I wish first to acknowledge my indebtedness to those who so generously shared their knowledge during those early days of theoretical considerations and practical arrangements.

To Professor Kenneth Lansing (University of Illinois) I owe the idea of exploring Piaget's theories as a basis for this work. His address at the NAEA (National Art Education Association) convention, Philadelphia (1965) appears to mark the first time that an American educator discussed the important implications of Piaget's theories for the teaching of art. Its application in this research has--from its inception to the final completion--been enriched by his continued interest and invaluable suggestions.

Professor Harrie Vanderstappen (Chairman, Department of Art, University of Chicago) kindly shared with me some of the wisdom and insights which have come from his several decades of absorbed interest in the concept of space, particularly as it found expression in the early aesthetic strivings of man. Much of my present theoretical stance--one in which understanding of spatial representation is an incorporation of aesthetic and historical concepts with classic studies of the development of child art and Piagetian cognitive theory--developed under his influence.

The former chairman of the University of Chicago Department of Art, Professor Ludwig Bachhofer (now in retirement), was kind enough to grant several extensive conferences during which pilot study drawings were examined according to theories of spatial development, especially those of Britsch. Allowing this imposition on his privacy and time was a gracious act on his part.

Out of Professor Phil Jackson's interest in creativity and the psychological and educational testing implications of this investigation, came much appreciated, valuable guidance.

The entire data collection stage of this research was possible only because of the generous support of Professor Elliot Eisner.

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His subsequent appointment at Stanford and the different theoretical framework of my study made further collaboration impractical, but I wish to express my gratitude for the stimulating association I enjoyed as his assistant on the Chicago study of drawings by disadvantaged children (1967) and for his enthusiastic encouragement of my own efforts in this area of research.

At the University of California, Berkeley where this work is reaching fruition, I feel deeply privileged to have been sponsored by George De Vos, Professor of Anthropology, who has broadened my awareness of the range of expressive behavior--of cultural potential and inhibition--within which man explores the possibilities of life in different societies. The riches of his intellectual and personal inspiration over the past four years were of immense importance to me.

The kindness, insights, cautions, and encouragement of the following professors of education at the University of California, Berkeley are deeply appreciated: Thomas Livingston who has been extraordinarily stimulating as he guided this research according to the disciplines of comparative education and his own sensitive response to experience in the field; Mark Luca, Supervisor, Art Education, whose generous sharing of his enthusiasm and vast knowledge in the field of child art has made my investigations easier and provided reassurances; Professor Lawrence Lowery who helped me explore connections between science, math, and art education in terms of Piagetian theory; and Professor Richard Mosier who gave thoughtful reading to the entire section on Piaget's stages and made insightful, provocative comments in regard to aesthetics and the philosophy of education.

Professors Staten Webster and Kenneth Johnson gave wise counsel regarding social stratification and problems of minority testing and inference.

Special recognition must be given to Dr. Warren Wollman, research psychologist at the Lawrence Hall of Science for the Intellectual Development Project under AESOP (Advancement of Education in Science-Oriented Programs) who was formerly an invited visiting

scholar ("collaborateur") from October, 1969 to August, 1971 in association with Jean Piaget at the Center for Genetic Epistemology, Geneva, Switzerland. His meticulous examination of the portion of this work relating Genevan stages to drawing development was not only a source of reassurance but was the basis for highly stimulating and enlightening discussion. I am deeply indebted to him for his generous and discriminating attention to my work. Any errors of interpretation which may appear would reflect only my own misconstruction of his comments.

The entire statistical analysis of data was done under the direction of Dr. Howard D'Abrera (Statistics Department, University of California, Berkeley), assisted by Steven Casey, an exceptionally competent programmer highly sensitive to the demands of this study.

My debt to Dr. D'Abrera is monumental, but incurred under the most pleasant of associations. Because of his personal interest in the content of this work, he was indefatigable in his search for highly creative ways to examine the data and consequently opened up new avenues of thought about many of the problems.

Over the years three assistants have worked with me on the massive job of setting up a system of identification coding and recording, development of comprehensive charts used as sorting criteria guides, and in the actual sorting of drawings. I would like to thank Freda Muelke, Alyssa Hess, and Juliette Williamson for their invaluable help.

Data collection overseas and in four American cities was arranged through the kind cooperation of the following investigators, assisted by research assistants especially selected for their interest and competence in this area of study: Dr. and Mrs. Edward Stalzer (Brazil, Amazon area), Professor Arrigo L. Angelini assisted by Mrs. Arrigo L. Angelini (Brazil, São Paulo), Dr. Svend Skyum-Nielsen assisted by Leif Aidt (Denmark), Professor Ernst E. Boesch assisted by Paul R. Baltes (Germany), Mr. Chr. Berthelsen assisted by Leif Aidt and Lars Møller Lund (Greenland), Mrs. Anita K. F. Chen Li assisted by Tsoi Heung Sang (Hong Kong), Professor J. M. Fuster, S. J. assisted by Homer Pithawalla (India), Professor

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Marcello Cesa-Bianchi assisted by Dr. Gabriella Rubini (Italy), Professor Akira Hoshino assisted by Haruo Nishimura and Koichi Hasegawa (Japan), Mrs. Betty B. Montgomery (U.S.A., Cincinnati, Ohio), Professor Max Rennels assisted by Mr. Joseph Salazar (U.S.A., Guadalupe and Tempe, Arizona), Dr. Winfield Christensen (U.S.A., Palo Alto, California), and Edwin Larsen and Edward Hakkarainen (U.S.A., Oakland, California). Professional and institutional details as well as current academic positions of the former graduate students are given in Appendix 1.

I would like to single out for special notice my very deep appreciation for the early encouragement, intellectual sharing, and warm, continuing support of Professor Ernst Boesch.

With gratitude and a feeling of tenderness, I thank the thousands of children and primitive adults who gave me the treasured gifts of their drawings--the privilege of a private glimpse of many creative spirits and poignant struggles for expression.

I thank also their teachers and school administrators who gave their time, permission, and cooperation.

A special gift should not go unnoticed. Chemists at the American Crayon Company generously arranged the donation of special heat-resistant crayons to be used by the Mundurucu and Carib Indians in the Amazon jungle.

And finally I must express my appreciation for the interest of Professor Alan Portis, former director of the Lawrence Hall of Science (University of California, Berkeley), who invited me to pursue this research under the auspices of this institution, to Professor Watson M. Laetsch, the present director, who extended this support, and to Robert Content, Assistant Director, for his kindness and exceedingly valuable assistance in regard to the administrative aspects of fulfilling the grant commitments.

The grant in Basic Research from the U. S. O. E. was of prime importance in bringing all of this work to a stage of completion. I wish to express my deep gratitude to those of the panel who recommended this study for funding and whose honest, thoughtful criticisms provided a constructive standard of expectation.

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Dr. Robert Beezer and Mr. Monte Penrey have provided a helpful and encouraging liaison with the U. S. O. E. and I wish to thank them for their interest and many good suggestions.

In conclusion, I can only express the humble but deeply felt hope that this work will be useful. It is the only return I can make for the riches which have come to me from the many kindnesses received.

Betsy Nan Hess-Behrens
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I INTRODUCTION

> To begin with, it is clear that if the development of various aspects of child thought can tell us anything about the mechanism of intelligence and the nature of human thought in general, then the problem of space must surely rank as of the highest importance.
>
> --Piaget and Inhelder (1956, Preface)

From blind kicking and stretching in the womb to silent memories at death all of life is organized in response to spatial demands and information. The strength and availability of sensory impressions depend on spatial distance[1] and all of our experiencing of the "other," of action and ideas, is transmitted through the complexity of a three-dimensional reality. From the lowly measuring of linoleum for the kitchen floor to an Einstein's magnificent vision of the universe or the artist's incredible sweep of expressive beauty[2] every act or experience must be transformed into a two-dimensional reconstruction in order to be held and manipulated as a mental image.

As Sigel (1971, p. 61) points out:

> How man thinks, what man remembers, what man perceives, and what man does with the knowledge that he acquires are derivatives of and dependent on man's basic capability to represent the world mentally. We tend to take for granted that ability to deal with the world representationally as a 'given.' . . . Our measures of intelligence

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[1] Edward T. Hall explores the approach to social and personal space in a variety of different cultures in the absorbing book, The Hidden Dimension, Doubleday & Co., Inc., Garden City, N.Y. (1966).

[2] The limitations of this study do not permit discussion of aesthetic space in terms of 1) gestalt psychology, 2) theories of form and composition, or 3) elements of primitive art. The literature in these fields is rich. Among some of the best examples are:
(1) Arnheim, Rudolf, Art and Visual Perception (1954, 1967).
(2) Langer, Susanne F., Feeling and Form (1953).
Santayana, George, The Sense of Beauty (1896, 1955).
(3) Boas, Franz, Primitive Art (1927, 1955).
Wingert, Paul S., Primitive Art (1962, 1965).
Jopling, Carol F., Ed., Art and Aesthetics in Primitive Societies (1971).

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> for the most part contain graphic symbols . . . Is it not ironic that much of what we know of cognition is based on response systems to representations? Yet we know little about this first step.

The Concept of Space and the Cognitive Role of Visual Imagery

Reduced to its simplest definition, one might say that the concept of space is the concept of object--animate or inanimate, real or abstracted--its classification and its relationships within and without. In reference to that aspect of concept formation involving perception, a quotation from Gibson (1950, p. 1) seems appropriate: ". . . the perception of what has been called space is the basic problem of all perception. Space perception is . . . the first problem to consider, without a solution for which the other problems remain unclear."

Explication of the subtle and complex relationship between the perception and the conception of space would go beyond the scope of this work[1]. Suffice it to recognize perceptual development as basic to concept formation. Perceptual functioning is more elementary; it is closer to the immediacy of organic response to natural stimuli which assures, according to Piaget (1966, p. 9):

> . . . only immediate and consequently limited equilibrium between the individual and the environment. Elementary cognitive function, such as perception, habit, and memory, extend it in the direction of present space [perceptual contact with distant objects] and of short-range reconstructions and anticipations. Only intelligence, capable of all its detours and reversals by action and by thought, is an extension and a perfection of all adaptive process. It tends toward an all-embracing equilibrium by aiming at the whole of reality and the accommodation to it of action, which it thereby frees from the initial *hic* and *nunc*.

It must be remembered that "intelligence" as used by Piaget has a meaning quite different from that which is commonly employed in current testing to assess measurable potential or hereditary

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[1] An important cross-cultural investigation of perception can be found in Segall, Campbell, and Herskovitz, The Influence of Culture on Visual Perception (1966). See also a related study of variance in susceptibility to perceptual illusions between cultures in Berry, Ecology, Perceptual Development and the Muller-Lyer Illusion (1968).

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endowment (Piaget, 1968, p. 7):

> Intelligence, the most plastic and at the same time the most durable structural equilibrium behavior, is essentially a system of living and acting operations.
> . . . this use of the term precludes our determining where intelligence starts; it is an ultimate goal, and its origins are indistinguishable from those of sensori-motor adaptation in general or even from those of biological adaptation itself.

It is in this sense--and this sense only--that the investigations of concept development in the present study are undertaken. It seeks only to determine the stage along a continuum which has been reached at the time of testing. Though the sequence is presumed to be unalterable, the rate of growth and the ultimate level reached are not.

Intelligence, according to Piaget, develops in a reciprocal relationship with what he calls the semiotic function which allows the representational evocation of objects and events which are not available to immediate perception. However, this function evolves only under the guidance of "representative intelligence" and includes not only drawing and mental image but also language, all of which can only "develop and be organized . . . [with] the constant help of the structuration characteristic of intelligence" (Piaget and Inhelder, 1969, p. 91).

It is significant that throughout much of Piaget's experimentation and investigation, drawings and pictures (as well as object manipulation) are used. "Words," he says, "are probably not a short-cut to a better understanding . . . The level of understanding seems to modify the language that is used, rather than vice versa . . . Mainly, language serves to translate what is already understood; or else language may even present a danger if it is used to introduce an idea which is not yet accessible" (Piaget, as reported by Laurendeau and Pinard, 1964)[1].

Beilin, Kagan, and Rabinowitz (1966, in Sigel and Hooper, 1968, pp. 382-393) investigated anticipation imagery in water level

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[1] Sherwood Washburn, in an October, 1972 address to the National Association of Biology Teachers, made the same general point.

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representation using pictures and demonstrations as part of the testing instrument, as opposed to verbal program training. They concluded that "when a child can develop an image of a complex object with at least a minimum of success, this image can be modified effectively by a confrontation with reality which leads to a more accurate representational schema." They found that the water level representation was ". . . more dependent upon nonverbal than verbal mediational processes" (p. 392).

This process is, of course, the same as the correction and testing of representations against reality, which characterize the drawing efforts of young children as they move from schematic to visually realistic styles.

A number of recent studies have investigated the effect of visual imagery on learning. Lynch and Rohwer (1971) compared verbal and pictorial elaborations and found that the latter facilitated both associative and response learning. Anderson and Hidde (1971) asked subjects to rate pronounceability or image-evoking value of 30 sentences. Given a surprise recall test, subjects who rated imagery recalled over three times as many words as those who rated pronounceability. Pavio (1969) found that the image-evoking value of words correlates more highly with learnability than any other characteristic examined including meaningfulness. Pavio and Yuille (1967) discovered that instructions to create mental images from words strongly facilitate paired associate learning. Gagné and Rohwer (1969) showed that pictorial materials are superior to verbal in methods of presenting equivalent information. Lumsdaine (1949) reported superiority of pictorial representations as stimulus items. Spangenberg (1971) demonstrated the superiority of pictorial over verbal display groups in learning nonsense syllables. Wicker (1970) showed the superiority of pictures to their labels in recognition and recall. Wimer and Lambert (1959) demonstrated that nonsense syllables attached to pictures were more readily learned than when attached to words. Gamsky and Lloyd (1971) used 20 kindergarten classes from rural school districts in a longitudinal study to determine the effectiveness of the Frostig Visual Perception Program on reading readiness and found that it increased

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the reading ability of the experimental group. Grace Petitclerc has recently prepared a documentary film demonstrating the use of visualization as a key to reading.

Not only do images and pictorial representations assist in verbal learning and recall, but it appears that there is a continuous, close developmental relationship between the pictorial and verbal capacities throughout childhood at least up to early adolescence although, according to Piaget, language lags somewhat because of its greater abstraction from the concrete reality of the child's experiencing.

Elements of differentiation, analysis, abstraction, and reconstruction are involved in the symbol-making activities of the mind whether they are verbal or visual. Vinacke's studies of children's language processes show a development which is parallel to those of drawings and concept development in general (1951, 1954). The studies of Meili-Dworetzki (1957) and Campbell (1958) indicate strongly that the same limitations that appear in drawings appear in the child's ability to verbalize about those drawings.

In the Netherlands, Stotijn-Egge (1952) studied normal and mentally retarded children. Non-performing children on the Good-enough "Draw-a-man" test of intelligence possessed no words; scribblers used only a few words; and those who were able to produce any kinds of recognizable drawings had more or less acquired language. Only a small proportion could copy forms beyond squares, circles, vertical crosses, or a simple human figure. About half of those using words could also draw a few other simple forms such as a house, but very few could copy a three-dimensional form placed before them.

Goodnow and Friedman (1972) review works calling attention to similarities between drawings and language in their report on a study, "Orientation in Children's Human Figure Drawings: An Aspect of Graphic Language." Their results "suggest the feasibility of using concepts from studies of spoken language for experimental studies of graphic performance."

It appears that in addition to its own intrinsic value as an aspect of concept formation, drawing activity can assist the

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acquisition of language skills. This may well be due to the suggestion given above that with drawings the child has a chance to examine his representations directly and make corrections. This is a necessary step in moving away from the egocentrism of early childhood and toward the introspection of the school years when the child learns to "think about his own thoughts."

Bruner (1960) says that the most basic thing about human memory is that unless detail is placed in a structured pattern, it is rapidly forgotten. Henle (1966) makes a similar observation when he claims that if material to be learned does not possess an internal structure, a structure must be imposed on it by the learner.

This is all related to Piaget's contention that language is transmitted to the child in the form of "ready-made," "compulsory," "conventional," hence "collective," signifiers. Symbols, on the other hand, are motivated, differentiated forms individually created and bearing some resemblance to that which is signified. Piaget insists that "the child needs a means of self-expression, a system of signifiers constructed by him and capable of being bent to his wishes" (Piaget and Inhelder, 1969). In this sense drawing is assimilative, but it is also a form of imitative accommodation. Piaget (Piaget and Inhelder, 1969, p. 63) notes that there are "innumerable interactions between the graphic image and the internal image."

One might then say that this symbol-making activity of the child is a form of adaptive behavior and, as such, is involved in the growth of intelligence.

Bronowski (1964) sums it up thus:

> Once a child can make images, it can also reason, and build for itself a coherent picture of the world that is more than separate bundles of sense impressions. . . Children and animals alike have to learn to coordinate their various senses and to recognize objects. But after that, animals fall behind. They have no power of imagination. That is, they cannot carry images in the mind; and without imagery, without an inner language, they cannot manipulate ideas.

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In another context[1] he discusses the methodology of science, agreeing with Whitehead's description of 50 years ago that it was a coupling of abstract reason and empiricism "playing leap-frog." However, he and Karl Popper both now insist that a third aspect is involved when experimental testing reveals a deficiency of the model which has been constructed. The next model, they claim, "cannot be constructed by any logical process of pure reasoning. . . . It has to be fixed and guided at critical moments by highly original (and in that sense personal) acts of conceptual imagination."

The anthropologist, DeVos, writes (in Kaplan, 1961, p. 601):

> Some scholars attempt to understand man as a symbolizing animal solely in terms of his development of verbal communication either as an inner language or a mode of external communication. The artist would never make such a mistake. Those working in the plastic or graphic arts seek consciously to control and to represent outwardly in visual or dramatic form, inner perceptions of which the person is deeply aware but which have no ready verbal referent. One may speculate that inner experiences are perhaps communicated symbolically to the mind prior to their expression in outer communication.

To Bruner (1970, p. 61) the two processes used by art and science alike are 1) "the construction and exploitation of the category of possibility, the formulated but empty category through which we search out new experience," and 2) "the construction of the tautly economical symbol."

The classic example of this creative phenomenon as given by Jung (1969, p. 26) and others is the age-old symbol of a snake with his tail in his mouth, which came to the nineteenth century German chemist, Kekulé, in a dream while he was absorbed with research into the molecular structure of benzene. Through a symbolic flight of imagination he made the association with the structure of a closed carbon ring, which indeed proved correct[2].

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[1] "Science and the New Humanism," Science Teacher, 35, 5 (May, 1968).

[2] Two remarkable books on this general subject are: Arnheim, Visual Thinking (1971) which treats visual perception as a cognitive activity and McKim, Robert H., Experiences in Visual Thinking (1972) which argues the power and importance of visual thinking

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As early as 1926, Dewey, in discussing affective thought, noted the role of imagination in both scientific and artistic endeavors: to recreate the world into "a more orderly place" (1926, pp. 144-45). He concluded that "probably a time will come when it will be universally recognized that the differences between coherent logical schemes and artistic structures . . . are technical and specialized rather than deep-seated."

Some 40 years later, Bronowski (1965, p. 19) wrote: "The discoveries of science, the works of art are explorations--more, are explosions of a hidden likeness. The discoverer or the artist presents in them two aspects of nature and fuses them into one. This is the act of creation, in which an original thought is born, and it is the same act in original science and original art"[1].

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and is directed largely at increasing this facility in adults through use of the exercises described therein. Of interest also is an article by David Ecker, "The Artistic Process as Qualitative Problem Solving," Journal of Aesthetics and Art Criticism (1963). Of course, Dewey's Art as Experience (1934) is a classic. See especially pp. 46, 73, 195, and 236.

[1]The vast literature on creativity defies examination within the range of this report; its relevance, however, is obvious. It is generally recognized that the major personality attributes of creative people and the characteristic elements of the creative act are the same whether directed toward science or art. Of special note are:

Barron, Creativity and Personal Freedom (1969), using among other instruments, the Barron-Welsh art scale;

Tayor and Barron, Scientific Creativity: Its Recognition and Development (1966);

Kagan, Ed., Creativity and Learning (1967), including essays by scientists as well as non-scientists;

Maslow, "Creativity in Self-Actualizing People," in Anderson, Ed., Creativity and its Cultivation (1959); and

Getzels and Jackson, Creativity and Intelligence (1962) including discussion of scientists and artists.

Note: Joncich (Clifford) takes issue with the authors of this last work in terms of the book's "culture-bound concept of creativity" (1964). (See articles in Jopling, Ed., 1971, with reference to creativity in primitive art for examples of other values.) If one agrees with Joncich (Clifford) in her assessment that the authors appear to be associating creativity with the "daring," "American" "Pioneer" type of scientist personality and intellect, then one must also note that it is training in this kind of mental ability for which technologically undeveloped countries so often seek educational assistance.

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The argument thus far has been an attempt to show that the concept of space involves development of the concept of objects, their classification and internal/external relationships. This transformation of three-dimensional reality into manageable two-dimensional form is dependent upon the ability to create and store representations which serve as internalized mental images available for recall, reconstruction, and recombination.

These representations in the form of visual images are not only useful in the development of language skills, but are somewhat prior to them and partake of a similar or parallel developmental structure.

Because of the adaptive function served by visual images--here of interest in drawing representations--it can be inferred that they are involved with the actual development of intelligent thought itself. The power of the symbol (internal visual image as distinct from language signs) is attested to in the imaginative creative acts of scientists and artists alike.

If then, the development of these visual images--which are so inextricably bound up with the development of spatial concepts, of creative, logical thought--can be examined through the study of drawing representations, we can learn something about the problems with which the child is struggling and those upon which he can build because of their successful solution[1].

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[1] Just as it was important to clarify the concept of intelligence in terms of the Piagetian orientation of this work, it is also necessary to comment on the relationship between the affective and the intellectual. Ignoring the emotional, the spiritual, the mystical, does not imply an undervaluation of their basic human significance. It is simply not the thrust of this study. Piaget explains: "What common sense calls 'feeling' and 'intelligence,' regarding them as two opposed 'faculties,' are simply behavior affecting persons and behavior affecting ideas or things; but in each of these forms of behavior, the same affective and cognitive aspects of action emerge, aspects which are in fact always associated and in no way represent independent facilities" (1966, p. 7).

And Einstein himself is quoted as saying: "The most beautiful and most profound emotion we can experience is the sensation of the mystical. It is the sower of all true science. He to whom this emotion is a stranger, who can no longer stand rapt in awe, is as good as dead. That deeply emotional conviction of the presence of a superior reasoning power which is revealed in the incomprehensible universe, forms my idea of God" (printed poster, source unknown).

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Previous Study of the Development of the Concept of Space

We have asserted that the development of the concept of space is basic to the development of representative thought and to the growth of logical thought in general.

Efforts to understand this development fill the literature. As early as 1926, Thorndike showed that those mental processes involving symbolization (such as space conceptualizing) and problem solving move up in altitude, broaden in range, and increase in complexity.

Thurstone (1938) considered it one of the primary mental abililities. The Psychological Abstracts give so much weight to the importance of studying and testing spatial abilities that the saturation over the past five years alone almost defied counting attempts. A list of paper-and-pencil tests alone as compiled by Smith (1964)[1] records some sixty-nine tests of spatial ability published between the years 1915 and 1961. According to Harris (1963, p. 5):

> By intellectual maturity is meant the ability to form concepts of increasingly abstract character. Intellectual activity requires: 1) the ability to perceive, i.e., to discriminate likenesses and differences; 2) the ability to abstract, i.e., to classify objects according to such likenesses and differences; and 3) the ability to generalize, i.e., to assign an object newly experienced to a correct class, according to discriminated features, properties or attributes. These three functions, taken together, comprise the process of concept formation.

Later he adds (1963, p. 194):

> With added experience, the child's concepts become increasingly abstract; they encompass relationships among aspects of an object, and they include relationships among objects.

Bayley (1957) saw general mental ability as a complex of components which changed in age both in number and in terms of contribution to the total variance, increasing according to movement from one stage to another. It was discovered that a "Sensory-Motor

[1] See Appendix 3.

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Alertness" factor was important up to age two; "Persistence," up to age four; "Manipulating Symbols," after four; and that a growth spurt took place around age nine.

These stages are roughly parallel to those which Piaget (1950, 1953) found to hold true as the four major stages of mental development: Sensori-Motor, Pre-operational, Concrete Operations, and finally, Formal Operations starting around age 10-1/2 to 11.

Piaget, with Inhelder (1956) refined these stages, adding substages and specifications as they related to development of the concept of space. These will be discussed in detail in the section on methodology.

Since 1885 (Cooke) and 1887 (Ricci), educators and psychologists have begun to take note of the developmental aspects of children's drawings. Among those who have made important contributions to the investigation of the progressive spatial sophistication of the maturing child are notably: Kerchensteiner (1905), Stern (1909), Rouma (1913), Burt (1921), Britsch (1926), Luquet (1929), Barnhart (1942), Read (1945), Lowenfeld (1947), Schaeffer-Simmern (1948), Arnheim (1954), Lindstrom (1962), Lewis (1962), and Eisner (1967).

As discussed above, taken in its broadest interpretation, any study of development of the concept of object would be a study of the concept of space. The above mentioned investigators were specifically concerned with the development of the relationship between objects--a development clearly related to age changes, not only in young children, but on up to adolescence, the elementary school years.

Werner (1948) has made an intensive study of the child's cognitive processes which also show a parallel to the development of drawing. He is also interested in the fact that persons or objects can be portrayed individually long before they can be shown in relationship to each other or their environment. It is the development of this ability which is of major concern in my study--achieved through building on the relationships and differentiations understood within a given object.

Luquet, as early as 1913, clearly felt that the child draws ". . . what he knows, not what he sees." This theme recurs

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throughout the literature, along with the conviction that this knowing grows as the process of concept formation develops along the lines of differentiation, analysis, abstraction, and reconstruction.

One has only to refer to the very comprehensive study of "Children's Drawings as a Measure of Intellectual Maturity" by Harris (1963) to recognize how convincing is the proof that the study of children's drawings provides a rich source of information about the intellectual functioning of the child. His careful and thorough analysis of the history, theories, and research connected with an exploration of this aspect of cognition is a basic source for anyone concerned with the development of child thought[1].

His conviction of the validity of this position led to an updating of Goodenough's scales on the "Draw-a-Man" test and development of the "Draw-a-Woman" test. These tests attempt to measure intelligence according to the level of concept formation reflected in the drawings of a child. Goodenough herself says (1926, p. 73-74):

> Very great differences are found among children with respect to the extent to which these functions [quantitative and spatial relationships] keep pace with each other . . . It is this inability to analyze, to form abstract ideas, to relate facts, that is largely responsible for the bizarre effects so frequently found among the drawings of backward children--the "Zusammenhangenlosigkeit" to which Kerschensteiner has called attention.

This work is useful in describing developmental drawing changes within the framework of a single object--the human figure. It, of course, can give no information about relationships between objects and is also inappropriate to the theoretical position of this study in that it focuses on assessing mental ability rather than merely describing the level of maturity which has been reached at a given point in time.

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[1] An excellent overview of child art development which is not limited to the purely cognitive aspects is Lark-Horovitz, Lewis, and Luca, Understanding Children's Drawings for Better Teaching (1973).

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Rationale and Orientation of the Present Study

Harris (1963, p. 19) concludes a brief historical survey of the study of children's drawings with a section including the following remark:

> The major early studies . . . have furnished a picture of developmental aspects of drawing that in general outline have remained unaltered to this day. . . That different investigators have located similar stages, that these stages can be established against an age scale, and that succession has been notably similar for most children, has been sufficiently well validated to establish the usefulness of the concept of stages or phases in describing the course of development.

Piaget contends that these stages follow an invariant sequence for all children everywhere and are likely to occur at approximately the same general age level under normal circumstances. Thorough understanding of each stage is implicit in the ability completely to grasp and manipulate ideas at the next successive level. This process can be hastened or slowed down, reversion to earlier patterns in a "comfort zone" may occur and may even appear in a more sophisticated context, but the sequence itself cannot be altered or the stages interchanged.

The research described in this present study attempts to examine this assertion by studying drawings from nine different countries and sub-groups to determine whether this development is invariant or affected by experience in different cultures.

It is clear from the studies reported in Anastasi and Foley (1936, pp. 689-726) that cross-cultural comparisons of children's art are not a new idea. Yet of those discussed in their article, only four showed specific concern with problems of spatial development, whereas emphasis was generally placed on cultural differences as evidenced by choice of subject matter. The authors indicated a need for more research in the field by the following comment:

> Examination of the extensive literature [on children's drawings] will at once reveal the widespread belief in the existence of definite developmental stages in drawing behavior . . . these stages are regarded as products of innate maturational factors and independent of

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> specific environmental stimulation. The data supporting such maturational views are not only inadequate and inconclusive, but the conclusions drawn are frequently inconsistent with the facts obtained. It would seem to the writers that the various stages of drawing behavior can most profitably be studied in the cases of children reared in widely different cultures.

The present study hopes to meet these criticisms through the following means. The study is not only cross-national, but includes a range from jungle non-literates to highly sophisticated children raised in a tradition of intensive art training. The developmental nature of drawings is not based on subjective observations, but instead data were examined in a context of psychological theory and reports of tasks which have already been replicated in a number of different cultures. No effort was made to support the idea of innate maturational factors unfolding spontaneously at similar ages throughout all cultures, but only the assumption that there is an invariant process of adaptive behavior in the stages of development--irrespective of the possibly variant rate at which they are reached and the level ultimately attained. Environmental stimulation is, in this study, considered to be a prime variable in this connection.

It is important to note in this regard that national or cultural style may be reflected in the drawings of older children who have passed into the period of formal operations, but is not expected with younger children who draw only what they can conceive. Since he has not attained knowledge of projective techniques, for example, it is difficult for him to reproduce them in a two-dimensional copy of a two-dimensional representation of three-dimensional space. Townsend (1951) studied the ability to copy and discovered that this ability is more related to form perception than to motor ability and that correctness in form comprehension was correlative with mental age.

In general, a concern with visual realism or abstract or national style is a concern of later childhood occurring around the ages of 9 to 11 according to the observations of most researchers (Burt, Rouma, Lowenfeld, Goodenough, et al.), an age corresponding

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to what Piaget finds as the end of the period of concrete operations. Meili-Dworetski (1957) found that imitation was a factor in children's drawings, but that it was not directed toward making an exact copy of a given model; rather, it involved a build-up out of many comparisons and discussion in unsupervised settings where children talked over their drawing efforts and were drawing freely--in other words, it was a learning situation. Gaddes, McKenzie, and Barsley (1968) studied "Psychometric Intelligence and Spatial Imagery in Two Northwest Indian and Two White Groups of Children." Their expectation that the highly sophisticated art style of their culture would give the Indian children an advantage over the white was not substantiated. Other factors may have been operating, but the cultural art style did not prove to affect their performance. Harris concludes (1963, p. 229) that "cross-cultural studies show . . . that the culture determines chiefly the peripheral or elaborative aspects of schemata, and are more influential in later than in earlier childhood."

Most tests of spatial ability involve verbal instructions and specific tasks depending on designs in a formal instrument[1]. However, by asking the child to call upon his own inner symbolizing resources to communicate content matter of his own choice and in his own culture context through drawings, it should be possible to examine spatial concepts which are free from the tester's culture-bound demands, expectations, and intellectual sophistication. All children tested in this research except the Mundurucu non-literates are in school and are familiar with crayons as a medium which is sometimes used in weekly art classes[2].

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[1]See Appendix 4 for examples.

[2]Salome (1967) did a study comparing the use of crayons as opposed to pencil and found that the same amount of detail was rendered in both media but that children filled more space on a 12 x 18 inches sheet of paper (the size used in the present study) with crayon than with pencil. The present choice of crayon as medium is thus appropriate.

However "culture-fair" such an investigation as the present one may seem to be, great discrepancies between groups are to be expected. Within each society there are those who are denied the potential of full participation in the main thrust or richness of their own culture by virtue of lack of education, poverty, and/or social alienation or isolation. In our country, Davis (1948) with Warner and Havighurst (1944), as early as the forties described the problem of social disadvantage most thoroughly as due to a complex of interrelated causes involving, among other elements, differences in values, in desire to achieve, in goals, in the availability of appropriate models, and alienation from a society which demands that individuals adapt while denying them acceptance. Frustration and defeat are built into such a system and the child attempts to cope with the inevitability of this defeat through withdrawal or hostility.

The severity of the problem lies not only in the anguish experienced by each child but in the impoverishment of a total society when it is deprived of the potential contribution of each of its members. Thoughtful educators continue to address themselves to understanding and solution of the problem: Riessman (1962); contributors to Passow, Ed. (1963, 1969); contributors to Webster, Ed. (1966); contributors to the entire Volume 40, Number 1 of The Review of Educational Research (February, 1970); Gordon (1971); and many others.

One may also think of entire societies as "disadvantaged," but only in the special sense of being denied the rewards of full participation in the sharing of the modern potentials of mankind, the right of full literacy of its members, participation in the "information explosion," modern health care, access to the means of technological development, material goods, and international power[1]. "Modernizing" is thus generally seen in Black's terms (1966).

[1] Recognition is made that these "rewards" are of a mixed nature, that, indeed, negative effects may well outstrip positive values. Yet we cannot escape the thrust of technology (White, 1959), nor can we reverse it. We must then, it appears, harness

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That efforts toward modernizing may be considered to be at the expense of spiritual development or warm, trusting human relations is a serious cause for concern in the minds of many, but one which is generally outside the scope of this present investigation. The personal conviction of the writer is, however, that there are potentials of human evolution which have barely been tapped at this point in time.

De Vos (1969, p. 343) reports that cross-cultural tests of intelligence "differentiate consistently among individuals within minority groups and sub-cultures, in the direction of predicting greater success in modernizing cultures in adaptation to formal learning and to highly evaluated occupations." Badri (1965), working with Sudanese children, discovered that differing degrees of modernization affected scores on the Goodenough quotient for nonverbal intelligence--the more modern, the higher the score.[1]

A test developed by Davol and Hastings (1967), based on a modification of Fleishman's (1957) Response Orientation Device, requiring each subject to "adopt other than his own point of view and use systems of reference," showed that kindergarten through third grade children from low socio-economic groups had more difficulty than children of the same age level from higher socio-economic groups.

Kidd and Rivoire (1965) constructed a test using only very simple abstract symbols to examine Piagetian theories about development of spatial concepts. They concluded that only items constructed upon the basis of very elementary topological properties were found to be "culture-fair," i.e., that differences between groups would be minimal.

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its dynamic power and direct it toward constructive ends. In addition to the many well-known American anthropologists and sociologists writing on the subject of technological development, one should look at the very lucid, sensitive discussion (a UNESCO report, in English), "Educational Assistance to Developing Countries and Disarmament" by the European psychologist E. E. Boesch in Zwischen Zwei Wirklichkeiten, Hans Huber, Publisher, Bern, Stuttgart, Wien (1971), pp. 263-333.

[1]Badri, Malik B., "Influence of Modernization on Goodenough Quotients of Sudanese Children," Perceptual and Motor Skills, 20 (1965), pp. 931-32.

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Even so, Nanda, Das, and Mishra (1965) report a study in Southern India in which failure to discriminate even the most simple geometric patterns accurately for urban, rural, and tribal children--between the ages of six and ten--showed that the tribal ones had the greatest number of failures. The authors concluded that "the ability to discriminate geometrical patterns varies directly with the degree of urbanization . . . the distribution of the total number of subjects failing to discriminate suggests geometrical patterns are more efficiently perceived by children from 'civilized' cultures" (1965, pp. 199-200).

In the water level representation task described in Beilin, Kagan, and Rabinowitz (1966) there were significant pretest differences between U.S.A. middle and lower class and between black and white children. Post-test conclusions showed a proportionate degree of improvement after experimental treatment.

In the results of Piagetian conservation tasks (largely spatial) given to matched groups of black and white first graders, Lepper (1967-68) found first of all a significant correlation between success on the Piagetian tasks and performance on the Metropolitan Reading Readiness test. He also made the interesting discovery that although upper and lower class whites did better than upper and lower class blacks as a group on all five tasks, middle class blacks and middle class whites performed equally on the first two though the whites did better on the last three.

Farnham-Diggory (1970) found differences between lower class and middle class and race in the performance of mathematics and map tests which required "intersensory coordinations of a visual or spatial nature."

Sigel (1971) found that lower class black children had difficulty on classification tasks when asked to cope with representations in the form of the "non-present or the inferential or representation of reality."

Renick (1972) using the Renick Perceptual Assessment Visual Form test of 34 graphic items, found differences in deductive reasoning ability between matched groups of black and white children which favored the latter.

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In terms of drawing development specifically, in an address (published in 1968) to the XVIII World Congress of INSEA, Prague, 1966, Hess (Hess-Behrens) reported that in a preliminary examination of first-grade drawings from four countries (collected for this present investigation) sorted according to Piagetian stage criteria, there appeared to be a significant disproportion of conceptual maturity between middle class and socially disadvantaged children as they started their first year of regular schooling.

Eisner (1967), investigating children's drawings of a playground scene in the Chicago area, found that the mean drawing score for the disadvantaged was about two-and-a-half categories below the advantaged on a developmental scale, and that at each of the four grades tested (1,3,5,7) advantaged children revealed higher drawing scores than the disadvantaged.

Using Lowenfeld's general description of developmental characteristics, Bondra's (1965) master's thesis analyzed the drawings of Pueblo and non-Pueblo children in Arizona. In addition to differences in awareness of spatial relationships, she found that the more limited Pueblo children demonstrated a lack of detail in their schema and tended to be non-visually oriented, showing an egocentric view of their environment.

Chambliss (1972) studied visual perception and creativity in disadvantaged high school students and discovered many of the same characteristics that Bondra described. She says in one place that "a number of [these] students . . . showed strong evidences in their art work of not having progressed since they were in first or second grade." In a study of the use of art in programs of compensatory education projects [Hess (Hess-Behrens), 1966], it was reported that the socially disadvantaged child was very apt to produce drawings characteristically exhibiting clichés, stereotypes, brevity, lack of cohesion, and limited range and detail of concept and information.

Tests using pictorial material in Africa have repeatedly shown unsuccessful performance. Biesheuvel (1949) emphasizes that pencil and paper tests, photographs, and pictures of any kind simply cannot be used with most African subjects because their unfamiliarity with

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the transformation required in two-dimensional representations of three-dimensional reality makes such material inappropriate for cross-cultural comparisons.

W. Hudson (1967) generally dismisses most pictorial aids to teaching in Africa because--according to his researches--they would probably "increase the likelihood of misperception and reduce the probability of comprehension" (1969, p. 156) where homogeneity of acculturation is at a low level.

Deregowski (1972) claims that experiments in Africa show that perception of pictures calls for some form of learning and is not a universal ability. A. C. Mundy-Castle (1966) makes similar observations about the poor scoring of Southern Ghana children in response to a series of pictures used to test spatial concepts. Testing for ability to recognize different points of view, he found his subjects quite uniformly restricted to an egocentric point of view which he interprets according to Piagetian theory.

A number of Piaget's (1956) Genevan spatial tasks have been administered in cross-cultural settings. The studies in Price-Williams (1969) show a uniform discrepancy between the higher performance of children educated in the West and lower levels attained by uneducated or traditionally educated children, especially in Africa (where most of these studies were undertaken). It was thought that Piaget's tasks would be relatively culture-fair because the activities involved and the objects used are of universal significance and simplicity. Yet observations of test performance showed repeatedly that difficulties arose whenever the subjects were called upon to visualize, to retain and manipulate mental images, to make transformations. Goodnow, for example, noted that greater error was encountered in a water conservation task when a picture of a dish was used in place of an actual container. This is reminiscent of Werner's (1948) studies which showed that a young child can copy a block building directly from a model before he can construct one from a picture shown to him. Goodnow (1968, p. 249) summarizes it thus:

> . . . there is the beginning of consistency in the tasks not handled outside the [middle-class, modernized]

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> group. This consistency is harder to define, but in a rough fashion they seem to be predominantly tasks where the child has to transform an event in his head, has to shift or shuffle things around by some kind of visualizing or imaging rather than by carrying out an overt series of changes. The spatial or perceptual aspect of these tasks comes as something of a surprise. It used to be thought that "disadvantaged" groups would be most handicapped on verbal or abstractive tasks and that imaging or spatial-type tasks would be fairest. This seems not to be so, and a division of tasks into "verbal" and "non-verbal" seems not to be the most fruitful that could be made.

Vernon's (1967) comments seem highly pertinent at this point when he suggests that we should try to dispel our sensitivity to direct testing of intellectual performance among non-literate peoples. We might extend his comments to include disadvantaged children wherever they may be found. He suggests (1969, p. 76) that if

> . . . they wish to achieve civilizations comparable to those of Western technological nations, but are severely handicapped at present by lack of intelligent, well educated manpower . . . it becomes reasonable to study their performance on Western-type tests, which are known to be relevant to educational and vocational success, in an attempt to determine their present strengths and weaknesses and to point to environmental handicaps that must be remedied if they are to make more rapid progress.

Phillips, in the UNESCO report of the Conference of African States on the Development of Education in Africa (1961, p. 100), says in part that "Although little is known at present about the role of education in lifting an economy at an early stage of development, there is a presumption and a certain amount of historical evidence that education is one of the main prerequisites to the movement forward into sustained growth"[1].

C. P. Snow (1963, p. 48) takes issue with those who would assume a hands-off stance in regard to the needs for modernizing education in undeveloped nations:

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[1] For an overview of problems and attitudes in this area, including observations by African nationals themselves, see Cowan, O'Connell and Scanlon, Eds., Education and Nation-Building in Africa (1966).

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> There is no getting away from it. It is technically possible to carry out the scientific revolution in India, Africa, S.E. Asia, Latin America, the Middle East, within 50 years. There is no excuse for Western man not to know chis. And not to know that this is the one way out through the three menaces which stand in our way--H-bomb war, overpopulation, the gap between the rich and the poor. This is one of the situations where the worst crime is innocence.

Snow is talking not only about practical assistance, capital investment, and the like, but also about assistance in developing a complete educational program leading to scientific know-how to combat basic threats to life and health. Snow feels that this Western involvement with helping others meet primal needs is a moral issue: "one mustn't despise the elemental needs, when one has been granted them and others have not. To do so is not to display one's superior spirituality. It is simply to be inhuman, or more exactly, anti-human" (p. 74).

Kenyatta (1938), fiercely proud of African culture, social relationships, and spiritual riches, admits that "There certainly are some progressive ideas among the Europeans. They include the ideas of material prosperity, of medicine, and hygiene, and literacy which enables people to take part in world culture. But so far the Europeans who visit Africa have not been conspicuously zealous in imparting these parts of their inheritance to the Africans . . ." (1962, p. 305).

Very much to the point in terms of the argument of this research is his statement (1962, p. 123), "A more sympathetic attitude would help the teacher to change from what is called 'educating the native along his own lines,' to educating the African for leadership in his community and people, and to make him fit to stand by himself under the strenuous conditions of the modern world"[1].

The reason for emphasis on African education and testing in this report is threefold. First of all, because of the fact that

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[1] In addition to the aforementioned, important considerations of African education can be found in Lloyd, Africa in Social Change (1969), in articles from Middleton, Ed., From Child to Adult: Studies in the Anthropology of Education (1970), in Scanlon, Traditions of African Education (1964), and in Fox, Ed., East African Childhood. A very poignant, personal account of traditional

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this present research is based on Piaget's theories, the large number of Genevan experiments which have been replicated there make Africa a developing area of special interest. Cross-Cultural Studies (1969) edited by Price-Williams is an unusually good source of information concerning testing of spatial concepts and representation as well as Piagetian theory.

Second, since this research is devoted to investigating the concept of space as it is related to the development of visual imaging, Africa--as an area with acknowledged difficulties in this realm--can be a source of important information about possible factors contributing to this problem.

Third, a number of the studies referred to above suggest that although difficulty with visual imagery is a social class problem in America, the problem seems to be particularly severe among the black students[1]. Herskovitz (in Middleton, Ed., 1970, pp. 265-66) suggests that if

> . . . we assess the acculturative situation of the Negro in the U.S. in the light of this differing interest in the several phases of his traditions and in terms of varied opportunities for the retention of Africanisms in the several aspects of culture, we find a certain coincidence between the two which significantly indicates a means whereby the carry-over of earlier traits not only could have been achieved but must in many cases have been consciously striven after.

In other words, there are certain aspects of the African cultural experience which may persistently operate even centuries and thousands of miles apart. We shall return to this later; for the moment suffice it to recognize that it is important to examine the problem of difficulty with pictorial recognition and representation in terms of socio-cultural differences affecting the process of

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training and the experience of a Western education is Laye, The Dark Child (1954).

[1]There have been a number of suggestions why this might be so including Pollack's (1969) speculation that darkly pigmented retinas may have greater difficulty in registering certain kinds of visual stimuli associated with receptor efficiency. This is an interesting speculation but, if true, is probably only one of many factors affecting the problem of visual imaging because the problem is not limited to Blacks.

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development, not ability per se.

In three of the studies mentioned earlier (Farnham-Diggory, 1970; Lepper, 1967; and Sigel, 1971), it is made very clear that the basic cognitive skills are present. Sigel, for example, claims that the black children had no difficulty at all with classifying (an important operational skill) when given the actual objects to sort; however, difficulties arose when three-dimensional toy representations were substituted. When pictures were used, the difficulty was increased, and thought connections became transductive where they had apparently been logical before.

Farnham-Diggory found that the Blacks scored higher than Whites on verbal synthesizing tasks which involved a serial rather than a simultaneous process of making connections. Using this skill as a prior step, they were ultimately successful in using the maplike symbols operationally (a task which otherwise demanded visual synthesis). She suggests that "Negro and white, boy and girl, old and young, may all have a wider variety of intersensory systems available for operational thinking than we imagine" (1970, p. 80).

Lepper's observation is that difficulty with subsequent conservation tasks is not as important as the fact that successful performance was achieved with the first one, because conservation of substance is a basic first experience of reversibility. He quotes Piaget as saying that conservation of substance is a "logical necessity . . . though no experience could have led to this notion" (because, of course, there is no way of measuring, testing, or proving as there is in the cases of weight or volume). Thus, argues Lepper, there is no innate mental difference between the matched groups of black and white children so that there must be something unique in their different experiences which kept the Blacks from equal performance in the application of reversible thought to other tasks.

We can, then, look to the following statement as not only related to these and other similar findings, but as absolutely basic to the overall position taken in this present study (Piaget and Inhelder, 1958, p. 337):

> In sum, far from being a source of fully elaborated 'innate ideas,' the maturation of the nervous system can do no more than determine the totality of possibilities and impossibilities at a given stage. A particular social environment remains indispensable for the realization of these possibilities. It follows that their realization can be accelerated or retarded as a function of cultural and educational conditions.

It would, of course, be impossible to isolate certain variables as being the major causes of poor performance by disadvantaged groups, because all these variables interact in such a way as to create a total configuration determining behavior. A number of factors have been observed as contributing to the total process.

Segall, Campbell, and Herskovitz (1966), for example, attribute differences in performance on spatial perception tasks to environmental differences, suggesting that a more "carpentered" setting may well provide opportunity for greater familiarity with rectangular forms and thus less susceptibility to the effect of geometric illusions. Since it is recognized that perceptual development is related to concept formation, the possibility arises that this may have added bearing, in some cases, on the performance of children in certain cultures[1].

Piaget (1964, p. 5), when asked to comment on the four-year time lag between the Martinique and Montreal subjects in the replication of his spatial tasks, is reported to feel that because living in Martinique poses few problems, there was "little call for questioning and struggling for solutions--in general, little call for either physical or intellectual activity."

McClelland (1961), in his extensive cross-cultural study comparing the need for achievement in mobile and stable societies, and among members within those societies, suggests that the degree of challenge in a given environment strongly affects motivation. If,

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[1]This may be questioned since wherever there is a tree or post at right angles to the ground there is always the possibility of making estimates, corrections and decentrations related to an external vertical/horizontal reference system. It is, however, an intriguing hypothesis and of additional importance because it reinforces the idea of cultural determinants operating on visual aspects of thought.

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on the other hand, the challenge is so great as to seem insurmountable, then the need for achievement may also be stifled.

One of the instruments used to examine this Need-Achievement factor is Aronson's (1958) Doodling Analysis. A comparative study of young people from the U.S., Germany, Japan, Brazil, and India (all countries included in the present drawing study) demonstrated that high N-achievers showed characteristically different treatment of space on the page, use of diagonals and other design elements, than those with low N-achievement.

In addition to environmental factors, N-achievement motivation has been considered as also related to direct training, teaching of self-reliance and freedom from parental control. Levine (1966) has studied achievement motivation in Nigeria and finds that such factors as population pressure, withdrawal of status respect, contemporary status mobility patterns, and availability of information also affect this need.

While recognizing that McClelland's observations regarding socialization patterns leading to need-achievement may well characterize development in some cultures, De Vos (1968[1]) takes issue with his emphasis on the "role of individualistically oriented entrepreneurial behavior" (p. 360). De Vos cites the case of the Japanese child who is not trained toward independence or self-reliance, but who does have a strong sense of family affiliation and a "moral imperative impelling the individual toward achievement" (p. 359) in order to bring honor to the parents who have sacrificed for him. Failure to succeed is a reflection on the entire family and its achievement goals. Motivation in such a society, then, is related more to avoidance of guilt than to prideful assertion of personal needs and success. Indeed, says De Vos, "Success for oneself only was considered a sign of excessive, immoral egoism" (p. 359). He concludes that achievement motivation must be examined in terms of the total cultural context

[1] "Achievement and Innovation in Culture and Personality" in Norbeck, Price-Williams, and McCord, The Study of Personality: An Interdisciplinary Appraisal, Holt, Rinehart and Winston, Inc., N.Y. (1968), pp. 348-370.

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of each society: of available social roles, the development and maintenance of a social self-identity, the socialization process in the primary family, and motives related to affiliation and nurture.

Referring directly to performance on spatial tasks, many of the studies in Price-Williams (1969) seemed to suggest that in cases where the society typically inhibits exploration and sensory stimulation among pre-schoolers, poor results were found. Inhelder (Tanner and Inhelder, 1958) found that extensive freedom of movement and tactile exploration led to better abilities in spatial representation. Furthermore, as one art educator expressed it, "We have found that the most unequal item these [disadvantaged] students come to school with is awareness of senses due to lack of experiences"[1]. He is talking here not only of exposure itself, but also of the meaning attached to random experience.

Of importance is the fact that in the regular environment of the disadvantaged child, there is often little exposure to the elaborating activity of a significant adult who has the freedom of time and the developed awareness to help mediate between undifferentiated sensory impressions and the concept-forming processes of his mind. See earlier references to studies of the disadvantaged child as well as Bernstein (1961), Carson (1965), Hess, R. and Virginia Shipman (1965), and Hess (Hess-Behrens) (1966).

In this connection Sigel (1971) presents a most useful theory of the "Distancing Hypothesis" in which he suggests that during the transitional period (2 to 4 years of age, i.e., leaving sensorimotor intelligence and embarking on pre-operational thought) the adult "assumes a more significant psychosocial role in increasing distance between self and object and hence contributes to the development of representational competence" (p. 72).

It is at this time, he suggests, that differences between middle and lower class parents are critical. Although he mentions the use of middle class "abstract-inferential" vs. lower class

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[1] Irrera, Leo, former Art Director, Newburgh Public Schools, New York, now New York State Education Department Consultant in Community Communications, as quoted in Hess (Hess-Behrens) (1966).

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"concrete-descriptive" language interaction and the middle class opportunity to provide "models indicating the relevance and pragmatic values of distancing" (p. 73), he also mentions the importance of providing a "relatively orderly, structured, and sequential environment"[1]. He suggests that this involves anticipations which are represented at a pre-verbal level by some sort of imagery. Sigel's ideas are exciting and provide, I believe, a very realistic approach to application of Piagetian theory concerning problems of cognitive development among the disadvantaged[2].

I should like to investigate some other possibilities along the line of searching Piaget's theories for a clue to the explanation of problems related to representations.

First we must recall that, for Piaget, intelligence constitutes an equilibration between assimilation and accommodation. Hence, cognitive growth is dependent upon development in <u>both</u> of these realms of adaptive behavior. Accommodation involves the process of adjusting to the realities, the demands of the environment. However, according to Piaget (1968, p. 8), "the individual never suffers the impact of surrounding stimuli as such . . . [i.e.] the pressure of circumstances always leads, not to a passive submission to them, but to a simple modification of the action affecting them." These modifications are the result of assimilating actions by which the individual absorbs stimuli and incorporates them into existing mental structures (repeatable patterns of behavior) thus changing them by rendering them compatible with his own uniqueness and the level of development he has attained. It is this constant interaction between subject and object which constitutes the mechanism of intellectual growth at "ever increasing spatio-temporal distances and along ever more complex paths" (pp. 8-9).

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[1]See also Hess (Hess-Behrens) (1966, pp. 1-16) for a discussion of this aspect of distancing in regard to visual elaboration and sequential experience.

[2]A cautionary note here is needed though perhaps obvious. Although most middle class families have many alternative routes guaranteeing a certain minimal degree of successful academic achievement for their children, there are unquestionably distant, emotionally barren, and "success-oriented" parents among them who

Environment is, of course, made up of physical and social stimuli. The immediate physical realm of the disadvantaged child is, as Sigel and others have noted, apt to be somewhat barren, devoid of variety, novelty, aesthetic appeal, and structured organization. Accounts of the contents of primitive huts quite often fit this same description.

Whereas the African child, for example, may be living in a lush natural environment, he is often left in the compound to tend to younger charges or taken out to work in the fields or into the wilds to learn survival skills. It is important to memorize the names and useful qualities of objects in the environment and to learn the correct ways to put them to use according to the demands of daily living.

The counterpart--without the alleviating reinforcement of natural beauty and social cohesion--can be found in the environment of urban ghetto life styles.

One must add to this the young child's lack of opportunity freely to explore even the limited offerings of the immediate environment for "most African babies are bound to and carried on their mothers' backs for the first year or two; hence not only is their vision restricted (largely to a rounded object), but also they obtain very little manipulative or kinesthetic experience" (Vernon in Price-Williams, 1969, p. 85).

Because in most primitive societies and in lower class families mothers usually must work away from home, babies--after weaning--are usually put in the care of grandparents, younger siblings, or sitters whose main interest is to keep them quiet and out of trouble. Descriptions of this attitude toward being "nurse" to a younger child are found in all three personal accounts in Fox, Ed., East African Childhood (1967). Even when the "nurse" is not in charge "African parents seem more apt to frustrate than to encourage curiosity and exploratory activities or to reward the

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relegate their children to parent surrogates as well as to a very real spiritual "poverty" which takes its own toll on many levels. It is outside the realm of this present discussion.

acquisition of skills. Thus to a remarkable extent preschool children are content to sit doing nothing, and they are notably passive and submissive when school attendance starts" (Vernon, 1969, p. 85).

Thus one might say that, in Piagetian terms, during the crucial sensori-motor and early pre-operational stages opportunity for adaptation--interaction between the individual and his physical environment--is meager and restricted largely to accommodative behavior as opposed to assimilative forms.

Examination of the adaptive possibilities within the social environment is of even greater importance. Here again the similarity between child rearing practices and cultural values of a "primitive" society is somewhat congruent with the descriptions of those found in disadvantaged segments of modern, achieving societies.

It is important to recognize that we are dealing here with generalizations which, though useful and valid, cannot be applied as such to individual societies and groups. They suggest, instead, an approach to understanding the problem: the unique manifestations of the problem must be considered as special cases within a wide range of human adaptive needs, historical environmental possibilities, and cultural styles.

The astonishing variety and subtlety of these differences--and the dangers of gross generalization--are evident in the most cursory perusal of such books as Mead (1928 and others); Cohen, Ed. (1961); Kaplan, Ed. (1961); Murphy (1961); Spindler, Ed. (1963); Moore, Ed. (1966); Fried, Ed. (1968); Wallace (1968); Lindzey and Aronson, Eds. (1969); Middleton, Ed. (1970); and Hsu, Ed. (1972); and in countless articles such as De Vos (1968, 1969).

However, certain "weak" threads continue to be woven into the fabric of poverty and traditional education. Yet, curiously, what is considered weak in terms of modernizing cognitive achievement may appear strong as a binding force in a society dependent upon conformity for survival and social cohesion.

Let us turn again to Herskovitz (1970, p. 271) in terms of relating American Negro behavior to its cultural origins as part

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of African social expectations:

> Slave autobiographies again and again testify to the respectful behavior exacted of the young slave toward his elders, and the punishment he received if he did not fulfill this expectation. But the importance of proper recognition of status, respect for elders, and the like is very great in West Africa itself; and it is here that one must look when considering points of origin.[1]

These comments by a Western observer are reinforced by the accounts of Africans themselves.

> Thus early and late, by rules of conduct in individual instances, by the sentiment of the group in which he lives, by rewards and punishments and fears of ceremonial uncleanness, the younger generation learns the respect and obedience due parents . . .
>
> The teaching of social obligations is again emphasized by the classification of age-groups . . . The age-group is . . . a powerful instrument for securing conformity with tribal usage.(Kenyatta, 1962, pp. 111-112)

> Children were trained from their earliest years to be respectful, obedient, and mannerly . . . punishment for children who misbehaved, however harsh, had to be accepted by them without question or complaint. Thus the children [were] respectfully submissive. (Lijembe in Fox, Ed., 1967, p. 15)

> She [Granny] could change instantly, grabbing hold of one of us and plunging her nails into his thighs, with commands never to misbehave again. She was good at imparting discipline, was Granny. . . . 'Now small boy . . . if you wet the bed again, I will pinch your thighs so hard that they will bleed. Do you hear?' 'Yes,' I said, and felt fear grip me. (Nzioki in Fox, Ed., 1967, pp. 86, 87)

> . . . it is the concern of all the relatives, not only parents, to bring up the child properly and make him fit into and be useful in the village community. . . .
>
> Children are expected to do all of these [servile] things without complaining. . . . If even the young child shows a tendency towards being lazy in doing these small home duties, the mother . . . may even beat the girl for it. (Apoko in Fox, Ed., 1967, pp. 64-65)

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[1] Herskovitz does not mean West Africa exclusively; it is merely the area he happens to be discussing because of its closer involvement with the slave trade. See also LeVine in Hsu, Ed. (1972) for an overall review of culture and personality research in Africa.

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> Our elders walked up and down, behind us and in front of us, to make sure that we had all obeyed their orders to the letter. Woe to him who would have the audacity to disobey! He would be cruelly whipped. . . . But who would have the audacity to disobey? (Laye, 1970, p. 100)

If we turn to studies of characteristics of child rearing in the U. S., we find a striking parallelism. Gordon, J. (1965) in a report on the poor of Harlem states that 60% of the mothers interviewed felt that children are just born lazy and 75% thought that the most important thing that a child can learn is to obey.

A summary of lower class child rearing practices can be found in Zigler [with Boyd McCandess, consultant, Review of Educational Research, 40 1 (1970)]:

- -- Emphasis on qualities of respectability (obedience, cleanliness, etc.) rather than internalized standards of conduct
- -- Expectation of specific behavioral conformities rather than focus on growth and satisfaction
- -- Low expectation of success rather than confidence in results of schooling
- -- Punishment related to the immediate consequence of action rather than intent
- -- Outward aggression rather than inward
- -- Denial as a defense rather than repression

We have tried to suggest thus far that adaptation--interaction of man with his environment--has in both its physical and social aspects emphasized the accommodative rather than the assimilative in some traditional societies and in some disadvantaged segments of modern ones. However, what is functional and of positive value in the former often becomes dysfunctional in the latter.

This stress on the accommodative even extends into the realm of play, an activity which should be one in which the assimilative aspects of mental growth could find greater outlet for expression and development. One has only to read the African authors mentioned above to discover how deeply African play, for example, involves imitative behavior preparing the children for the "correct" adult roles.

Sigel (1971) describes his own studies of play activities and

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story telling among lower class American black children as well as Smilansky's (1968) work with underprivileged children in the Middle East. There appeared to be little dramatic, representation play of the sort frequently associated with middle class children: the play was often motoric and limited to reenactments of life rather than "condensation of symbolism" which Sigel attributes to the middle class child's play as he has observed it.

We see further evidence of conformity and emphasis on the accommodative if we look at the art of highly traditional societies. In many cases, because art objects serve a religious purpose, their creation is restricted to the efforts of one or two specially authorized persons. At the outset, then, the possibility of innovation is limited to the potential of only a few minds in each generation.

These artisans in turn are restricted to the use of forms and design elements which are cultural givens. Not only are the design elements prescribed, but their meanings are unchangeable: conformity is mandatory. In contrast to many Western societies, however, every member is therefore qualified to judge the work because he also has learned these design elements in the course of his cultural/religious training and can determine how faithfully they have been executed.

Artistry finds expression in exquisite craftsmanship and in the richness of spirit with which the artist has imbued his work: refinement, rather than innovation, is the artistic objective[1].

The mature artist, using the design conventions which have been handed down through centuries, is engaged in a powerful cultural expression. It would be considered extreme arrogance to interpose self-created symbols with purely personal meanings onto a collective spiritual expression.

It should be made very clear that in the context of this discussion only the social role of art--as it is related to certain aspects of cognitive adaptation in the Piagetian sense--is being considered. Absolutely no inferences can be made regarding value

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[1] I am indebted to Professor George De Vos for this useful juxtaposition of terms.

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judgments about that role, nor the aesthetic qualities of the art itself.

In any event, it is suggested that art in many non-literate societies could be thought of as dependent upon a conventional system of signs to be memorized in much the same way as language and word meanings are. Their inviolability and continuity of agreed-upon meanings contribute to the spiritual strength and social cohesion of the group. Yet in this sense of serving as signs rather than being self-created symbols one may again see evidence of accommodative conformity--as opposed to assimilative alteration--dominating adaptive behavior.

If we turn our attention now to members of a disadvantaged segment of a modern society where there is also emphasis on conformity and prescribed role expectations, where child rearing practices and family affiliations often follow similar patterns, and where creating expressive art is outside the realm of the average person's activities, consideration of adaptive behavior (as related to Piaget's discussion of signs, symbols, and the semiotic function) might shed some light on the fact that art educators routinely describe certain characteristics of the work of socially disadvantaged children as involving "stereotypes" and "clichés." It may well be that, among other factors, the pressures of conformity and social acceptance have caused them to seek safe conventional "signs" rather than to explore the possibilities of personal symbols. In a society which values uniqueness and individualism, these young efforts are often not understood and certainly not rewarded.

Furthermore, since there are few agreed-upon aesthetic values which are part of the young child's routine training in many modern societies, and since he is exposed to much vulgar commercial art, comics, and a glut of cheap imitations and poorly designed material goods, it is not surprising that imitative accommodations to such a model often produce pathetically barren clichés[1]. If exposure to

[1]The negative effects of commercialism are offset to a great degree in some countries such as Japan, for example, which has a highly structured, sequential art program--the same for all children--which begins with the first year of schooling and continues throughout. Familiarity, appreciation, and maintenance of

at least the variety--if not the quality--of environmental stimuli is limited by poverty or rural isolation, the problem is of course compounded.

If then, the growth of intelligent thought is an adaptive process involving the dynamic interaction of accommodation to and assimilation of the pressures and challenges of the environment, if this psychological adaptation is interwoven with the development of mental images, and if the development and quality of these imagings is due to development of representations through the semiotic function, then educational process is ultimately dependent upon opportunity for rich experiencing and exploration of this function from the earliest days of childhood on. Among these early possibilities, art constructions and drawings play a unique role, as has been discussed earlier[1].

An important aspect of this uniqueness--and one especially relevant to the foregoing discussion--is that art experiences involve both the assimilative and the accommodative aspects of adaptation.

During the early stages, as Piaget points out (Piaget and Inhelder, 1969, p. 63), drawings are largely assimilative in character. The child creates his own symbol system: he alters, interchanges, combines, recreates, examines, works, laughs, and starts again, free from external pressure to conform either to reality or to a convention of culturally determined signs.

Of exquisite significance is the fact that within this individual, personal freedom to create, forms emerge which are identical with those found in all cultures at all times and even in prehistoric caves. To me, this more than any formal testing ever carried out, attests to the equality of all men, to the basic mental structures which can be developed equally to whatever extent the environment inhibits, allows, or stimulates, and the society chooses.

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inherited aesthetic standards is the pride and responsibility of all members and is an integral part of the entire socialization process.

[1]"Art instruction . . . will come to be considered the prime training ground of visual cognition, once perceptual imagery is recognized as the vehicle of productive thinking in all disciplines." (Arnheim, 1968)

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That this development follows an invariant sequence in the growth of intelligence as Piaget's work suggests, seems not only consistent and reasonable, but also reassuring and practical, for it frees educational planning from the vagaries of fads and suggests an approach to be considered in making innovative changes.

At a later stage in this development of mental images through drawing, children are no longer satisfied with their own constructions because,with the onset of the decline of egocentrism, they begin to check their work against immediate visual perceptions, to seek explanations for appearances, and to reduce incongruities in their representations. At this point semiotic functions take on a more accommodative aspect in an effort to understand and imitate nature. This kind of conformity has a functional quality in terms of growth, for it involves an active effort to investigate natural laws rather than mere compliance to rote learning and social conventions.

Since this takes place at the age when most children start school, it is the responsibility of educators to encourage this natural curiosity rather than to distort their efforts by giving correct, ready-made answers, pictures to copy, personal explanations and prejudices, trivial tasks and amusements, and superficial "cultural enrichment."

As the child develops in understanding, refinement of perception, and cognitive skills, he begins to operate fully in both accommodative and assimilative functions, thus allowing him to create and reassemble personal, visual symbols in a free, adaptive interchange between his unique inner world of mental concepts and the increasingly understood outer world of sensory reality and natural laws.

Lansing[2], in an address to a seminar on child art (1966), summarized his conviction that Piaget's theories have important

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[1]See Piaget's discussion of universal elements in educational planning in "The Right to Education in the Modern World" in the UNESCO compilation, Freedom and Culture (1951).

[2]For a work incorporating these important ideas into a larger art studies context, see Lansing's Art, Artists and Art Education (1969).

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implications for art educators and undertook to show that not only can drawings be used as a measure of conceptual growth, but that the act of drawing actually fosters intellectual growth. He made the following points, based on Piagetian theory:

1. Perception results from the nature of the perceptual apparatus and from learning.
2. Perceptual development is facilitated by perceptual movement.
3. Conceptual development is facilitated by perceptual movement.
4. Percepts and concepts follow the same developmental pattern but percepts develop more rapidly.
5. Drawing is largely dependent upon conceptual images. Hence, drawing is dependent upon perceptual movement.
6. Drawing itself is a form of perceptual activity. Consequently, drawing contributes to concept development.
7. If accurate concepts of nature are important, it is necessary to draw from nature more often than from memory.

Piaget himself states (1969, p. 313):

> Our hypothesis . . . presumes that notions add an essentially new element to perceptual data, a framework within which they are consequently incorporated and often corrected. This framework itself cannot derive from perceptual data (by simple abstraction and generalization) because it constitutes a system of transformations, not a system of configurations.

Thus, drawing serves an important intermediary function in the development of mental images by correcting and transforming the data from visual perceptions according to the conceptual framework within which the child performs these activities.

Lansing's last point is of special interest in the context of this study for we have noted that the young child's images are fragmentary and contain incongruities which become more and more disturbing and demanding of correction as he grows older. Therefore, examination of drawings done from memory of an object or a situation can, by the same token, give us a remarkable amount of information about the child's level of cognitive functioning in general.

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As early as 1907, Claparéde (and 1909, Ivanoff) began to study the correlation between drawing and school ability. More recently Hoffman's (1958) study of children's drawings in kindergarten and first grade measured performance against teachers' ranking of general maturity, functioning in school, and abilities. Correlations between drawing evaluation and teacher evaluation were also computed with certain objective tests: Metropolitan Readiness Test, Draw-a-Man Test, Sangren Information Test, and Pintner-Cunningham Primary Mental Abilities Test. All correlations were significant at the 5% level. He concluded:

> Since the educational aim is to establish programs which will aid children in getting the best possible start in school, it is important to perceive the pupil as a dynamic person whose pattern of readiness needs to be observed, tested, and judged in as many aspects as possible. Drawings evaluated by criteria such as were used in this study can provide valuable knowledge for furthering our understanding. The positive results from this small, selected group suggested the need for parallel studies with greater numbers of children.

If we recall the repeated observations that the ability to visualize, to understand and make representations, seems to distinguish middle-class, modernized children from others in successful performance on tests of spatial conceptualizations, and that pictorial materials eluded comprehension by uneducated or traditionally trained children (particularly in Africa), then we should carefully examine those factors which may lead to such results and explore the ways in which children can be assisted in developing this aspect of their cognitive functioning.

In order to accomplish this goal, we must first use an adequate measure to determine the level of visual imaging which has actually been attained. In this study, drawings from a wide variety of populations were sorted according to criteria used in Piaget's description of normal stages in the development of the concept of space.

It is hoped that in this way a contribution may be made to these much-needed investigations.

All of the foregoing, then, should suggest that in areas where low drawing scores obtain, it might be well to consider a heavy emphasis on development of sensory awareness and art activity in educational planning. As Sister Geoffrey, Art Director for the Cabrini Experimental Project in Chicago, expresses it:

> I feel very strongly about the importance of visual experience as a source of creative expression that would eventually permeate the whole of the child's learning. Art experiences are of the problem-solving type and, because I feel the teacher of art provides for divergent thinking in such problems, this should affect other problem-solving experiences faced by the child . . . I found these [disadvantaged] children fresh and spontaneous, but lacking in the experiences of sensitive looking, sensitive feeling, seeing, smelling. [in Hess (Hess-Behrens), 1966, p. 33]

Assumptions and General Hypothesis

It is assumed that:

1. Examination of the concept of space in children's spontaneous drawings can give information about their level of cognitive functioning.
2. Children's spontaneous drawings can be used as a reasonably culture-fair testing instrument.

It is hypothesized that:

1. Similar developmental characteristics will appear in drawings made by children in all social classes and societies.
2. These characteristics will appear in the same sequence in all groups.
3. The level attained and rate of development will vary according to socio-economic and educational opportunities within groups.
4. The degree of modernity in a society and prevalence of literacy will affect the rate of development and level attained.
5. There will be a correlation between reading and drawing scores.
6. The extent of contrast in drawing performance between social classes will be greater in more sharply stratified societies than in those with a more homogeneous structure.

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Comparisons of the degree to which the above hypotheses are true should provide reliable data which may be used to explore these differences, the causes to which they may be related, and as a source of useful information for programs of planned change, development, and stimulation of academic and creative potential.

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II PROCEDURES AND METHODS

TOTAL POPULATIONS

The drawing test was administered to a total of approximately 9,000 children from the following countries: Brazil, Denmark, Germany, Greenland, Hong Kong, Italy, India, Japan, and the U.S.A.

In each country drawings were collected from a sample of middle class students and from a sample in the lower socio-economic bracket. Within each group approximately 100 were collected at the first, third, fifth, and seventh year of regular schooling, making a total of some 400 drawings per group, or approximately 800 per country for the major urban sampling. Lesser numbers are found in some of the special groups, such as the Mundurucus.

Populations included in this study are those where contacts were already available (or made possible through a chain of references and requests) so that arrangements could be made to provide a wide sampling of the major areas of the world, including large cities from transitional as well as advanced technological societies. In addition there is one set of Greenland towns based largely on a fishing economy, one impoverished rural Yaqui Indian community, one group of nomadic Eskimo hunters and sealers, and three non-literate Amazon Indian jungle groups[1].

The following tables (pp. 42-46) of interesting descriptive statistics give comparative data related to the hypotheses stated in the introductory section.

Caution must be exercised in examining these tables--and the final results--so that causal inferences between the variables will not be made. Although there may be interesting correlations between several variables, this is due, instead, to a complex of causes acting upon all of them and upon their interrelationships[2].

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[1] Limitations are obvious--particularly the omission of an African sample where "firm" arrangements on four separate occasions all failed to materialize in time for inclusion. More extensive sampling is desired and planned for some future date.

[2] Warnings about this and other general problems involved in comparative studies related to education can be found in a number of recent books, including: Kazamias and Massialas, Tradition and Change in Education: A Comparative Study (1965); Bereday, Comparative Method in Education (1966); Eckstein and Noah, Scientific Investigations in Comparative Education (1969); and Noah and Eckstein, Toward a Science of Comparative Education (1969).

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The tables which follow give some pertinent information regarding educational and economic indicators for the countries in this study. All data is taken from the following source:

Charles Lewis Taylor and Michael C. Hudson, et al, World Handbook of Political and Social Indicators, 2nd ed, Yale University Press, New Haven and London, 1972.

In each case countries are ranked from highest to lowest according to the column containing the most significant information in the table.

TABLE I[a]

Literacy

Country	% Literate	Age Base 15 and up except where indicated	Source[b]
Denmark	100		2
U. S. A.	99		0
West Germany	99		1
Japan	98		0
Italy	92	6+	1
Hong Kong	71		0
Brazil	61	10+	1
India	28		0

[a]Taylor and Hudson, Table No. 4.5, pp. 232-235.

[b]Sources:

0 - U. S. Agency for International Development Economic Data Books, U. S. Government Printing Office, Washington, D.C., 1967.

1 - UNESCO Statistical Yearbook, 1965 (Paris, 1967).

2 - Moshé Y. Sachs, Ed., The World Encyclopedia of Nations, Harper & Row, New York, 1967.

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TABLE II[a]

Literacy Increase (circa 1950 & 1960)

Country	% 1950	% 1960	Annual Average Increase in % Points
Brazil	49	61	1.2
India	19	28	0.9
Italy	86	92	0.6
U. S. A.	97	98	0.1
(other countries not given)			

[a]Taylor and Hudson, Table No. 4.a, p. 205.

Sources: UNESCO Statistical Yearbooks 1965, 1967.

TABLE III[a]

School Enrollment Ratios

Country	Adjusted Ratio (actual duration of schooling in terms of no. of years required and provided)	Unadjusted Ratio (total effort of country)
Japan	93	74
U. S. A.	93	87
Denmark	90	72
West Germany	90	78
Hong Kong	80	64
Italy	69	60
Brazil	47	41
India	44	38

[a]Taylor and Hudson, Table No. 4.3, pp. 225-228.

Source: UNESCO Statistical Yearbook, 1967 (Paris, 1968).

Date of Information: 1965

Definition of levels: UNESCO Statistical Yearbook, 1966 (Paris, 1968), p. 30.

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TABLE IV[a]

Educational Expenditure

Country	U. S. $ per capita	as % of GNP
Denmark	122.74	5.8
Italy	60.34	5.5
U. S. A.	188.55	5.3
Japan	41.97	4.9
West Germany	64.90	3.4
Hong Kong	12.09	2.9
India	2.06	2.0
Brazil	4.63	1.7

[a]Taylor and Hudson, Table No. 2.2, pp. 30-33.

Source: U. S. Arms Control and Disarmament Agency, Economics Bureau, "World-Wide Military Expenditures and Related Data, Calendar Year 1965, Research Report 67-6," U. S. Government Printing Office, Washington, D.C., 1967.

TABLE V[a]

Gross National Product

Country	GNP per capita in U. S. $	Growth Rate: Recent Period 1960-1965	Growth Rate: Longer Period 1950-1965 (except where indicated)	Source[b]
U. S. A.	3575	3.2	2.0	1
Denmark	2120	4.0	3.0	1
West Germany	1901	3.4	5.5	1
Italy	1104	4.2	4.7	1
Japan	861	8.2	7.8 (1952-1965)	1
Hong Kong	421	no info.	no info.	-
Brazil	267	1.0	2.1	0
India	101	.6	1.7	0

[a]Taylor and Hudson, Table No. 5.5, pp. 314-321.

[b]Sources: (continued on following page)

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0 - U. S. Agency for International Development, Office of Program and Policy Coordination, Statistics and Report Division, Gross National Product: Growth Rates and Trend Data by Region and Country, RC-W-138, U. S. Government Printing Office, Washington, D.C., 1967.

supplemented by:

_____, Selected Economic Data for Less Developed Countries, U. S. Government Printing Office, Washington, D.C., 1967.

1 - United Nations, Statistical Office, Yearbook of National Account Statistics, 1966, New York, 1967.

TABLE VI[a]

Urbanization

(% of population living in cities of 100,000 or more)

Country	1950	1960
Hong Kong	80.1	100.0
West Germany	48.4	51.5
U. S. A.	43.9	50.5
Japan	26.7	41.9
Denmark	33.5	34.2
Brazil	17.5	25.6
Italy	20.2	24.2
India	8.1	9.0

[a]Taylor and Hudson, Table No. 4.1, pp. 219-221.

Sources:

Collected under the direction of Kingsley Davis. Published by International Population and Urban Research, Institute of International Studies, University of California, in World Urbanization 1950-1970, Volume 1: Basic Data for Cities, Countries and Regions, Population Monograph Series, No. 4, University of California Press, Berkeley, 1969.

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TABLE VII[a]

Scientific Capacity

Country	Contribution to World Scientific Authorship[b] (natural sciences only--proportion of all authors of scientific papers in the world) averages of % in years 1967, 68, 69	Contribution to Scientific Journals[c] (natural, physical and engineering) actual number, 1961
U. S. A.	41.70	6,000
Japan	4.22	2,820
Germany	6.89 (east & west)	2,560 (west only)
Italy	1.98	1,530
India	2.26	670
Brazil	.16	650
Denmark	.57	400
Hong Kong	.03	0

[a]Taylor and Hudson, Table No. 5.6, pp. 322-325.

[b]Compiled by Derek J. de Solla Price, Department of History of Science, Yale University from International Directory of Research and Development Scientists, 1967, 68, 69.

Note: East and West Germary are combined because of difficulty in ascertaining correct addresses from information given.

[c]Charles M. Gottschalk and Winifred F. Desmond, "World-Wide Census of Scientific and Technical Serials," American Documentation, 14 (1963), pp. 188-94, and further correspondence with Gottschalk.

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Not included in the tables, but also relevant, is information about art education throughout the world. Three recent sources are of particular interest. In May, 1965 a special issue of Art Education, the Journal of the National Art Education Association, was devoted entirely to international art education. In April of that same year (1965) Barkan, M. gave a special report on "The Education of European Art Teachers" at the NAEA eighth Biennial Conference, Philadelphia, Pennysylvania. And for subtleties in art education attitudes and emphases between countries, one should read Art and Education, Report from the XVIIIth World Congress of INSEA (International Society for Education through Art) Prague, 1966, Dr. Igor Zhoř, editor.

NATIONAL SAMPLES

The following is a list of cities and number of schools cooperating in this study. The names of research participants, assistants, and institutions will be found in Appendix 1.

Country	City, Town, or Area	Number of Schools
Brazil	São Paulo	2
	Amazon Province Para	
	Cururu	1
	Tiriyos	
	Bocca	
Denmark	Copenhagen	4
Germany	Saarbrücken	5
Greenland	Egedesminde	1
	Holsteindsborg	1
	Sukkertoppen	1
	Godthåb	1
	Frederikshåb	1
	Julianehåb	1
	Thule	1
Hong Kong	Kowloon	3
India	Bombay	5
Italy	Milan	7
Japan	Tokyo	3
U. S. A.	Cincinnati	5
	Tempe and Guadalupe	2
	Oakland	7
	Palo Alto	1

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Again, cautions are in order: the particular city involved in this study cannot represent the country as a whole, nor can the particular schools used, in every case, represent the city, etc. Furthermore, much of the variety and flavor of a nation is missed by including only an urban sample[1].

SES SAMPLES

As discussed in the Introduction, within societies there are those who are denied the potential of full participation in the main thrust and richness of their culture by virtue of lack of education, poverty, and/or social alienation or isolation. For the purposes of this study, these are identified as the Lower SES. Generally following McClelland's and Piaget's theories, those who would show a high N-achievement score, that is, those who are motivated to struggle for this participation and are neither inhibited by the above factors nor members of the established elite, are identified as the Middle SES.

The ways of determining the SES are given below. Unfortunately, it was not feasible to use the same method in all cases.

It must be noted at this point that neither statistically nor inferentially could there be a suggestion of equivalence between socio-economic classes cross-nationally. Obviously, this is an intra-cultural relationship: the condition of the disadvantaged of Oakland, California, U.S.A., for example, simply cannot be compared to the condition of the impoverished of Bombay, India or to the lower working class of Copenhagen, Denmark.

It would seem that in those societies displaying a relatively homogeneous structure in terms of economic security and educational opportunity, urban-rural classifications might provide more interesting contrasts. This refinement in data collection was not

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[1] A poignant excerpt from an India letter expresses this important idea better than any formal statement I might make: "India does not exist in its westernized cities like New Delhi and Bombay. It exists in the . . . villages, where rural life has little in common with life . . . in the cities. It exists not in its swift IAC planes, but in its third-class railway compartments where there is little sitting (or breathing) space. The glory of its ancient past resides in Ajanta, in Ellora, and in the Taj Mahal, and not within the air-conditioned walls of a posh hotel."

possible at the present time.

In the case of a non-literate society, homogeneous, and surviving largely on a subsistence basis (for example, the Amazon Indians), there would be no clearly defined socio-economic classes. However, there are differences in terms of degree of isolation, contact with missions, and with outside civilization.

The following is a description of socio-economic class samples by city or area:

Brazil, São Paulo

Two schools were chosen as representative of middle and lower class, one in the heart of São Paulo and the other a public school from a working class area on the periphery of the city.

There is no art training at the elementary level in either school as it is considered "a part of recreational activities."

Elementary education is compulsory only through the fourth grade so that there are many drop-outs and all children going beyond that level would constitute a relatively more select population.

In place of fifth and seventh grades, then, the first and second grades of their "secondary" schools were substituted to bring the upper age limits to 12 or 13.

The secondary school for children of the Lower SES is primarily an industrial-vocational school. However, art training is given daily by a special art teacher as opposed to the academic program for Middle SES children which provides for special training only twice a week.

Reading scores were obtained here.

Brazil, Amazon area

Three groups constituted this sample and are of interest because of the difference in degree of contact with civilization (and its material goods) and exposure to missionary education.

The first is at the Cururu village of some 250 Mundurucu Indians near Santarem where three Franciscan Fathers and a group of Brazilian nuns run one school for about 12 boys and another for about 20 girls. In addition to some academic subjects, they are taught practical skills such as farming, carpentry, mechanics, masonry, etc. for the boys, and cooking, sewing, and farming for

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the girls. They are encouraged to wear clothes.

A small cooperative trading post is maintained by the fathers; a grinder is available for their use as well as a small saw-mill. A 5-kilowatt hydroelectric generator is powered by water stored in a reservoir which the Indians built, bringing water to it through a 12-foot wide, 5-foot deep, and 1-1/2-mile long canal which they dug themselves using only picks and shovels.

There is an air strip near the village so contact with civilization is not too difficult.

The second group at Tiriyos is in an isolated area but one which can be reached by plane. They are in a savannah grassland area north of Obidos near Akotipa, close to the border of Surinam. They stem from the Carib Indian group and do not speak the Tupi language as do most of the missionaries and Mundurucus.

Both they and the Mundurucus paint their bodies, carve on nuts, shells, etc., and are exposed to reading and writing. Thus they are used to creating designs using tools of some sort, and in working with color. However, crayons and drawing on paper were a new experience for both groups.

Clothes, given by the priests, are worn part of the day, but then only to protect from mosquitoes.

This is a small, undeveloped village with only one missionary living among them. Their houses were only round or elliptical roofs on poles, whereas the Mundurucu's were oblong. Both groups began to enclose them in imitation of the priests.

The third group was made up of a small group of Mundurucu jungle rubber gatherers who collected at a remote loading dock along the river at Bocca. Apparently their only contact with civilization takes place when an occasional river boat stops to pick up the crude rubber they have collected; the only building in evidence was a crude shelter used only on such occasions.

Denmark, Copenhagen

Four schools were used to obtain the social classes desired. However, a very detailed occupational rating scale was used to determine the social class of each individual who became part of the study.

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Through a misunderstanding, the SES division in Copenhagen was between the very high professional/managerial class and the very low unskilled and semi-skilled manual workers (instead of between middle and lower class as elsewhere).

Because test administrators were unable to fill the quota of 100 per grade per social class using only these designated schools, some children from the middle class in each school (and living in the same outer surroundings) were used to fill the gaps in that school. They were assigned to high or low according to their level within the middle class range--those closest to the extremes within the middle range being chosen for inclusion. Out of a total of 800, 64 "lower" class were added in this way, and 83 "upper" class.

Art is a regular part of the curriculum in all Danish schools and is taught by a teacher who is particularly interested in the subject, although rarely having special training beyond that routinely required for credentialling.

All children are given one lesson per week except at the third grade level where boys are given two extra separate classes per week.

Crayons are common, but since they wanted to use pencils also, they were allowed to do so.

Germany, Saarbrücken

This city is an outgrowth of an ancient Roman settlement which grew up around a bridge constructed over the Saar River. Little difference between middle and low classes was expected because so many international influences have been felt through the centuries by all classes alike in this prosperous, newly rebuilt, highly industrialized city.

Social class was determined by school classification according to the area of the city where each was located. Subjects were drawn from five schools to make up the sample.

Although the art curriculum is the same for all schools (with two hours per week for first grade, three hours for third, two hours for fifth, and one hour per week for seventh graders), no specially trained art teachers are provided. Art instruction is left to the chance skill and inclination of the regular classroom

teacher.

At the time of this testing the German system still provided for tracking into vocational-oriented or university-oriented programs starting at around age 10 or grade 5. There is now an orientation cycle around grades 5 and 6 during which evaluations are made determining each child's educational future.

Greenland

Six West Greenland towns made up the major part of the Greenland sample. In these the level of social, educational, and occupational conditions are very much alike, fishing being the primary industry[1].

All Danish children were sorted out of the sample because they are of the very upper and governing class with a lifestyle and stimulus-rich home environment unknown to most West Greenland Eskimos.

Social classes (high and low) were determined on the basis of the Danish occupational code-list. Special Greenland occupations were adjusted to this list with the generous assistance of Professor Verner Goldschmidt, University of Copenhagen, a sociologist who had conducted previous researches in Greenland and with Pie Barfod, a (then) political science Ph.D. candidate who was a statistician from the Royal Greenland Department.

The art program was identical to the Danish curriculum with the exception that one teacher in Frederikshåb and several in Godthåb had further education in art.

Also included in the Greenland sample are 51 drawings from the remote settlement of Thule[2], far to the North. These inhabitants are direct descendents of the polar eskimos and still live mainly as sealers and hunters, taking long travels by dog-sled from one hunting ground to another. In 1954 the Danish government built a small, modern town for their use as a permanent settlement between

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[1]For a beautiful and informative booklet describing Greenland society in transition, see Greenland: Arctic Denmark, published by the Ministry of Foreign Affairs of Denmark, Press and Cultural Relations Department, Christiansborg Castle, DK 1218 Copenhagen K, Denmark (Date not given: after 1971). Special articles about Greenland are also frequent in The American Scandanavian Review.

[2]Not to be confused with the Thule Air Base approximately 125 miles to the South of this area.

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travels. Only a small handful of Danes live among them. The school from which these drawings were collected is a boarding school for 60 children in the Thule area.

Hong Kong, Kowloon

Three schools were used to obtain the necessary sample. In Hong Kong schools are usually "class schools," that is, in any one school all students tend to be from the same SES. The first school is a government primary school in a resettlement area which contains Lower SES residents. The second is a free secondary school for the Lower SES. The third is a private school in the middle range of expense and SES which continues on into secondary schooling.

The first school has regular weekly lessons for all classes but no specially trained art teacher. The second school also has regular weekly lessons for all classes but given by two trained art teachers. The third has one trained art teacher for all levels but art classes are not compulsory at the secondary level as they were up to that point.

All classrooms are streamed according to formal tests taken the previous year but correlations between general level of ability and drawing scores were not included in the present research design.

India, Bombay

Social class was determined by school, public or private, as in Hong Kong. Four schools were used to make up the sample. In the low SES schools, the regular classroom teacher gave the art lessons at grades 1 and 3, whereas a trained art teacher taught grades 5 and 7. In one middle class school art was taught at all levels by a specially-trained teacher, and in the other middle class school this was also true except for the first grade.

The pattern of amount of time devoted to art is not consistent from school to school or from grade to grade. One lower class school devotes two periods a week to art at each grade level; the other increases this to six periods a week at grades 5 and 7. One middle class school starts with three periods a week, which is increased to four starting with third grade. The other middle class school starts with one, then two, then three periods a week for upper grades.

All schools except the low SES municipal school use crayons in the lower grades. In this school only black lead pencils are used until water colors are provided at fifth grade.

In all schools art is generally taught by providing a picture, picture element, or craft object to be used as a model by all. Reading scores were obtained here also.

Italy, Milan

Seven schools were used to obtain the appropriate sampling of lower and middle class subjects. Although SES designation was determined individually by an occupational rating scale, most lower class children were found in homogeneous classrooms whereas the middle class sample came from mixed classrooms and schools.

Art training is a regular part of the curriculum only in the seventh grade: two hours per week with a special art teacher. In the primary school (through grade 5) art is taught by the regular classroom teacher who determines how much time and emphasis will be placed on the subject. Apparently, drawing is increasingly neglected up until the seventh grade when it receives the special attention mentioned above. Crayons are not as common as colored pencils and the size of the paper was larger than is usual.

In the first school (predominantly lower class), art is given a great deal of attention at the first grade level, especially with a Montessori teacher who allows the children to spend most of their time in drawing activities.

The second primary school generally represents the high social class level, but one in which middle class children can also be found. The principal here is very interested in art training and tries to stimulate her teachers to emphasize art activities and give the children good training.

In the third primary school of mixed SES, art was neglected and the children were not accustomed to drawing.

Two of the four secondary schools are directed by a religious order where special art teachers are provided and art training is a highly valued activity.

Reading scores were given in this country. However, since Italian is a highly phonetic language and easy to learn, reading

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ability is not considered by them to be highly discriminatory. Teachers were therefore asked to give a cumulative score which included verbal ability in general.

Japan, Tokyo

Individual SES assessments were made largely on the basis of occupation, all within one grade school. However, at the seventh grade level, two schools were used, one representing each social class.

Art is part of the regular curriculum throughout Japan and standardized text books are used by all grade school teachers. It is taught for two class hours per week in all grades except the first where three hours per week are devoted to this activity.

All schools in this study have an art teacher who was graduated from the Tokyo University of Fine Arts and crayons are a common medium for all young children. Free and imaginary drawing characterizes most first grade activity while greater structuring is evident at higher levels.

In Japan, more than elsewhere, art as an integral part of every child's education appears to be related to an overall high cultural valuation of the aesthetic. Although self-expression is being encouraged more in recent years, it is still an expression within discipline and a generally accepted philosophical and aesthetic stance. Nishimura[1] refers to some of these aspects when he mentions that "the concept of balance and the strain towards the closed system are also crucial [in Japan]. We feel much insecurity when we see a wide blank [space] in the lower part of a drawing." Also important among Japanese is "the affectionate relationship of men to their surrounding nature. How men conceive and sympathize [with] nature will influence their perception of the world."

IQ scores were given for one class per grade (except the first) but were not used in the present correlation design.

U. S. A., Cincinnati, Ohio

Here social class was determined solely by school, the lower class sample being drawn from an elementary and a junior high school

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[1] Haruo Nishimura, one of the research assistants on this study who is also an artist (private correspondence, 1966).

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in an extremely impoverished Black area, most families being public welfare recipients. The middle class sample came from an elementary school and a junior high in an advantaged all-white area.

A small group of Appalachian migrant workers' children was included in the sample from one of these predominantly Black schools. An additional small sample was obtained from Chicano children from Texas in a migrant center school. This latter group had no art training at the center but had been taught some hand crafts by their cultural leaders.

As for the regular school program, art is incorporated into the total classroom experience in the first and third grades, but the quality depends on the inclination and ability of the regular teacher. "Hand-work" is common, but drawing instruction is minimal until the fifth grade when an art teacher gives special art classes five times every two weeks. In seventh grade art classes are elective but plentiful so there is a wide range of exposure to art training. However, an effort was made to select only children for this study whose training at this level had been average or minimal.

Reading ability was estimated by teachers in terms of total school population, not just with respect to the particular school.

U. S. A., Guadalupe, Arizona

The drawings here came from first, third, and fifth grade Yaqui[1] Indian and Mexican children, all of whom had no art training except that provided by the regular classroom teacher three periods per week. My information is that "the entire village of Guadalupe would rank extremely low on a Warner-Meeker-Eels test."

These children then attend junior high school in the Tempe district along with a few low SES Anglo children. Here they have one semester of art five periods per week with a trained art teacher. Interesting though it may have been, unfortunately no individual ethnic identifications were given for children in the Arizona population.

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[1]For more information about these descendents of Mexican Aztecs see Spicer's chapter on the Yaqui in Perspectives in American Indian Culture Change (1961).

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U. S. A., Oakland, California

To complement the Cincinnati sample, permission was given to test in seven Oakland schools so that a group of lower SES whites and middle class Blacks might be obtained. Oakland schools have been subjected to a great deal of testing recently, so cooperation was spotty and unpredictable--depending on the interest and grace of the individual principals and teachers.

Since social classes are mixed in all but two of the schools, which two were located in extremely depressed areas of the city, SES designation was determined as accurately as possible using occupational ratings from information given by children, or school files (where permitted), or by teacher evaluation where they chose not to supply occupational information.

Certainly a multiple index (for example, the McGuire-White Index of Value), one using some combination of these variables--education, occupation, religion, source of income, area of residence, status of home ownership, and the like--would give a more reliable assessment of social class.

The limitations and inconsistencies of using the method I did are obvious, particularly since information about parents' education is missing. However, it was the only one available under the circumstances, and even then, difficult to obtain[1].

In a discussion summarizing these problems, Hodgkinson (1967, pp. 97-99) concludes: "Even with all the foregoing taken into account, the most widely used index of social class is occupation . . . and correlates with other indexes of class very well."

In 1947 NORC (National Opinion Research Center) at the University of Chicago conducted a study of the public prestige rating of some 90 selected occupations. Known as the North-Hatt study it was first reported in Wilson and Kolb, Eds., Sociological Analysis (1949)

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[1] In Oakland not only the principals but the teachers, also, have a remarkable autonomy. Although the research was officially approved and cooperation in the designated schools was encouraged, some individuals simply refused to supply the information because they were too busy, or because they felt it to be an invasion of the child's privacy.

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and later reprinted in Opinion News (1947, pp. 3-13). Discussion and a final report of this study appeared in Reiss, A. J., Jr. and others, Occupations and Social Status (1961). Pertinent to the defense of using the NORC rating scale is Dudley Duncan's chapter (VI), "A Socioeconomic Index for All Occupations," from the above in which he states (p. 115):

> Information available for constructing the [NORC] index consists of characteristics of the persons engaged in the several occupations, as reported in the [1950] census. Previous chapters have shown that several census items of this kind bear a high relationship to the NORC prestige scores. In particular, the educational status and income level of the incumbents of an occupation were found to correlate highly with the prestige rating of the occupation. [emphasis mine[1]]

The original 1947 study, replicated in 1963 in order to measure changes over time, is discussed by Hodge, R., Siegel, P., and Rossi, P. in "Occupational Prestige in the U.S., 1925-1963" in Bendix and Lipset, Eds. (1966, pp. 322-334) and in a shortened version in the American Journal of Sociology (Volume 70, 1964, pp. 286-302).

Based on these discussions, the NORC Occupational Classification index seemed to be the most reliable measure of SES available for our use. A 1970 updating of the 1960 Hodge-Siegel Prestige Score was adapted to the 1970 U.S. Census Occupational Codes by Frances D. Harris of NORC. This is the version which was used for the SES coding of the Oakland study.

Duncan (1961, p. 159) suggests that the general cut-off point between white-collar and blue-collar jobs is roughly 38.5 (on the 1960 scale) but that there is some overlap in both directions. The range found therein was 82 high to 12 low. The Oakland high was 69 and our low group included welfare recipients who are, of course, not listed. A tabulation of occupations given in the Oakland study showed 35 to be the approximate median, hence it became our arbitrary cut-off point. Since our schools were chosen from generally middle class and lower class neighborhoods, it seemed to be an

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[1] See also Blau, P. and Duncan, D., American Occupational Structure (1967).

appropriate decision.

Of the six elementary schools tested in Oakland one was in an extremely depressed Black neighborhood where emphasis was placed almost totally on reading and math; one (which had exterior art done by a junior college environmental design class) was in a largely Chicano, cannery, port area; and four were in mixed middle class neighborhoods. In two of these latter schools the principal and teachers encouraged art activities and were very interested in this study.

Only one junior high was available for study and it was in a mixed, middle class area.

One class period per week is assigned to elementary school art activities in Oakland. It is taught by the regular classroom teacher or occasionally by parent volunteers. Although art supervisors have always been available for assistance when requested, they are rarely called upon by the teachers.

The junior high school has four specially trained art teachers and requires that art be studied five times a week for at least one semester of seventh grade.

U. S. A., Palo Alto, California

This small study was undertaken merely to examine the use of A, B, and C styles of drawing and is not included as part of the larger investigation of drawing development.

All children were middle class whites except for one or two Asians from professional families. Art, though taught by the regular teacher, was incorporated into the general curriculum and was allotted no less than one or two class periods per week--more at the discretion of the individual teacher. The first and fifth grade teachers had special art training and there was a two-hour art project after school every Friday afternoon for interested upper-graders.

TEST ADMINISTRATION AND INFORMATION RECORDED

The children were simply provided with identical sets of six crayons and a sheet of 12 x 18 inch white drawing paper and were asked in their own language (as translated locally) by their own regular classroom teacher, to draw a picture of themselves at

play with friends near their home or school. Standardized instructions were minimal (the same as in Eisner's study) and identical insofar as equivalence of linguistic meaning systems permitted.

All drawings were given identification coding according to information provided on the teacher report sheets and that which was supplied by the research assistant in charge of each local project. These assistants were selected by the professors cooperating on this study and assuming responsibility for overall supervision in each country.

Because some questions were later raised regarding the use of these instructions (claiming them to be too formal and uninspiring), a different version was given to the Oakland sample some six years later. (See Appendix 4 for both versions.)

In any event, teachers were requested to give no other information, minimize--or ignore if possible--the suggestion of testing, and refrain from giving help or ideas. In both cases teachers were allowed to paraphrase these instructions according to their own style so long as they did not go beyond the information and general suggestions provided.

Despite efforts to encourage children to become involved in their own expression, there were a few drawings obviously traced or copied. This occurred most regularly in India where art instruction involves using a model.

Pencils were permitted in addition to crayons where requested (especially Denmark, Greenland, and India).

Some samples (notably Denmark, Greenland, and Oakland) felt it more appropriate to use that portion of an entire class period which was left over after instructions, dispensing of materials, collection, etc. It is likely that, in effect, this was a common situation. Actual testing time, then, would vary between 30 minutes and 45 or so. There is no way to be sure from country to country and classroom to classroom.

Information recorded included date, sex, age (rounded out to nearest year), grade, school, country, teacher's name, ethnicity, and reading score (where available).

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OVERALL JUDGING PROCEDURE

Since this investigator had the prior opportunity of assisting on the Eisner (1967) study and was also involved in the training of judges, she is assured that this type of sorting into drawing categories can be accomplished with a high level of confidence. This assurance is repeatedly reinforced by a review of art education studies in which inter-judge agreement is reported. Eisner's study of 1,100 drawings, for example, showed 99.19% corrected agreement between two independent judges (Eisner, 1969) and more recently Gutteter (1972)--using Rouse's Rating Scale for Painting (1965)--reported that a random sampling of drawings submitted to two independent judgings yielded a correlation coefficient of .9163.

Before undertaking the sorting of the data to be used in this research, a pilot study of 50 drawings each from fifth graders in Milan, Italy and Tokyo, Japan was undertaken in consultation with Professor Harrie Vanderstappen, Chairman of the Art Department of the University of Chicago and Professor Ludwig Bachhofer, former chairman of the same department and one-time student of Britsch (mentioned earlier).

The approach used to determine the applicability of our criteria in both cases was joint discussion of the problems evident in the efforts of children from widely differing cultures. Each drawing was examined and unanimity reached before passing on to the next. Also considered were implications for further study comparing the development of the representation of space in children's drawings with that of the history of mankind's earliest recorded efforts up to periods of classical antiquity in both the Western and Oriental worlds.

An additional pilot study was conducted on three separate occasions among 169 first, third, and fifth graders at an elementary school in Palo Alto, California. The intent was to study sets of drawings--made at different times by the same children--in order to examine consistency of response and refine as needed the final consolidation of drawing criteria with Piagetian theory.

Training of the research assistant for the final study involved a two-month period during which the same procedure was used as in the pilot study with Professors Vanderstappen and Bachhofer. The drawings from four countries were examined in this manner.

In addition, two large wall charts were constructed as immediate visual guides to be referred to throughout the sorting task. One was a chart showing Piagetian stages incorporating the development of concepts in the following areas: growth of logical thought; classification; early number and pre-number experience; topological to Euclidean geometry; projective geometry (linear perspective, perspective changes, shadows); structuring space in terms of vertical and horizontal axes; measurement. Points of conservation were underlined and general developmental changes were noted.[1]

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[1] Sources used were:

Piaget, The Child's Conception of the World (1929, 1967).
Piaget, The Psychology of Intelligence (1950, 1968).
Piaget and Inhelder, The Child's Conception of Space (1956).
Piaget, Inhelder, and Szeminska, The Child's Conception of Geometry (1960).
Piaget, The Mechanisms of Perception (1969).
Piaget and Inhelder, The Psychology of the Child (1969).
Inhelder and Piaget, The Growth of Logical Thinking: From Childhood to Adolescence (1958).
Flavell, The Developmental Psychology of Jean Piaget (1963).
Lansing, Drawing: An Aid to Concept Development (1966).
Sigel and Hooper, Logical Thinking in Children (Research based on Piaget's Theory) (1968).
Brearley, et al, The Teaching of Young Children: Some Applications of Piaget's Learning Theory (1970).
Copeland, How Children Learn Mathematics (Teaching Implications of Piaget's Research) (1970).

The above texts will hereafter be referenced by author and date only. Among other useful sources relating to Piaget's theories, the reader may wish to examine the following:

Ginsberg and Opper, Piaget's Theory of Intellectual Development (1969).
Furth, Hans, Piaget and Knowledge: Theoretical Foundations (1969).
Furth, Hans, Piaget for Teachers (1970).
Almy, Millie, Young Children's Thinking (1966).
Lavatelli, Celia, Piaget's Theory Applied to an Early Childhood Curriculum (1970).
Boyle, D. G., Student's Guide to Piaget (1969).
Elkind, D. and Flavell, J., Studies in Cognitive Development: Essays in Honor of Jean Piaget (1969).

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The second chart was composed of a large number of small, simplified drawings, arranged in stages to correspond with the Piaget chart. These were examples of the typical kinds of pictures which would exhibit drawing characteristics basic to criteria used in designating each category.[1]

Using duplicate sets of charts as a constant standard for reference, the remaining populations were coded separately and drawings for which a category was not immediately obvious were set aside for joint discussion and final agreement later.

The entire sample of 9350 drawings was then examined (one by one) by the principal investigator to check for possible error due to visual fatigue or accidental miscopying of numbers.

Finally, a conference was held with Dr. Mark Luca, Supervisor of Art Education, University of California, Berkeley, during which a spot-check and discussion of the application of criteria--using Oakland, California drawings as the sample--took place.

No further judging or discussion was considered necessary.

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[1]Both charts are too complicated and unwieldy for reproduction here but will be refined and simplified for possible use in teacher education programs.

0075

DISCUSSION OF SORTING CRITERIA

As mentioned earlier, developmental aspects of child art have been a growing source of interested speculation and study for close to a century. Given slight variations in descriptive terms and age groupings, there has nonetheless been a remarkable consistency in those characteristics seen as definitive of sequential stage categories. Insightful and richly informative as these studies have been, they have usually been examined chiefly in the following ways, rather than by being imbedded in an existing developmental theory of cognition: a) similar drawings have been grouped together and the mean age thus determined at which certain characteristics seem to appear (e.g., Appelgate, 1966; Eisner, 1967), b) the drawing behavior of children at various age levels has been observed and common attributes singled out as exemplary of each age (e.g., Lindstrom, 1962; Cleveland Study, Lark-Horowitz, Barnhart, and Sills, 1939), c) these descriptions often refer mainly to individual elements taken out of--or not included in--a spatial context (e.g., Lewis, 1962; DiLeo, 1970; Kellogg, 1969; Goodenough, 1926), or d) where total spatial organization is considered, discussion usually centers on growing perceptual and/or personality development related specifically to distinct expressive style or creative artistic ability (e.g., Schaefer-Simmern, 1948; Lowenfeld, 1947; Stanford Studies in Perception [Silverman, 1962; Salome, 1965; Rouse, 1963; Kensler, 1964; McWhinnie, 1965; Efland, 1965]; McFee, 1957).

Regardless of the correlations to be investigated within a research design, if one merely wished to compare other variables with drawing style differences or similarities of children at various ages, he could--with confidence--turn to the categories of any of the major writers in the field of art education; their data collection procedures, emphasis, theoretical stance, and implications might vary considerably, but the general developmental categories would exhibit remarkably predictable descriptive conformities.

Regardless of the usefulness of research categories, however, the imposition of rigid stage criteria onto responses can often

create the dilemma in which some data resist classification and must be discarded as unusable (Appelgate, 1966: 6,000 out of 8,000 unused), or relegated to special categories of "mixed responses" (Eisner, 1967: 5% unclassifiable out of 13 categories; Dodwell, 1963: on seven Piaget spatial tests "mixed response" was the largest of four categories in each test by as much as 162 to the next highest--14 in one case).[1]

Because of all of the foregoing considerations, the methodological thrust of this research is somewhat different from that of much that has preceded it. Rather than to establish categories based on drawing style criteria per se, the attempt here has been to examine categories based on the intellectual problems with which the child is groping in terms of the growth of logical thought and spatial concepts. The drawings in this case are merely a non-verbal medium for exploration of these realms of child thought seen in a wholistic context of the general development of the intelligence as this term is understood and used by Piaget.

Since the traditional empirical approaches in art education research, such as those above, have repeatedly validated the consistency of drawing behavior stage descriptions, if the Piaget approach is also valid then one would expect there to be a strong correspondence between the results of sorting drawings in the two approaches.

As a matter of fact, Piaget himself refers to the work of Luquet in The Psychology of the Child (Piaget and Inhelder, 1969, pp. 63-64) and claims that the value of the stages as Luquet describes them "attest to a remarkable convergence with evolution of the spontaneous geometry of the child" and constitute an "introduction to the study of mental images which obey laws closer to those of conceptualization rather than to those of perception."

A detailed description of sorting criteria (including Luquet's terminology) follows in the next section, but there are some more

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[1] I am indebted to Professor Vanderstappen for his constant reminder that because of the unique spirit behind each external expression, there are as many categories as there are children and, as such, each is a source of wonder and respect. Yet there are overall "rules of form, measurable categories" which "change according to the growth and development of the judging power of the artist's

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general considerations regarding assessment of problems at each stage which must be examined first. In a sense, as suggested above, it is the problems which are put in sequential order and children--depending on environmental/hereditary enrichment or converse impoverishment--will struggle with or solve them at varying paces.

"Groping" is an important aspect of the Piagetian concept of adaptive movement into and out of stages and thus implies that many transitional type responses and mixed categories should be expected and dealt with, not discarded: they are reinforcing of his theories rather than delimiting.

The problem of assessing correct stage designation is further complicated by the existence of vertical and horizontal décalages (a Piagetian term literally translated as "unwedging, uncoupling" or loosely as "temporal displacement" [Flavell, 1963, p. 21, text and footnote #1]). In the one case--horizontal décalage--we find that although a certain level of operational sophistication may have been reached in one type of problem (e.g., conservation of number), the child may not be able to apply these same cognitive structures to the contents of a different task (e.g., conservation of volume).

Vertical décalages suggest a different phenomenon, that there are hidden structural similarities between seemingly disparate tasks from one stage to another. The classic example usually given compares the complex graphic map-making ability of the 12 year old with the baby's ability to locate himself spatially in terms of the general lay-out of his home as he creeps from room to room.

Another sorting difficulty--unique to this study rather than to Piagetian methods--is that a drawing time limitation was imposed as a control (a class period, not to exceed 50 minutes). Unfortunately this means that a number of drawings appear to be incomplete. The question is, of course, which are unfinished because of a wealth of ideas and detail for which there was not enough time, and which are unfinished because the cognitive problems were

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. . . [or child's] . . . insight." ("Insight" is seen here as a "complex of senses, reason and intellect.") [Vanderstappen, 1966-1972, privileged communication.]

insurmountable or there was a paucity of expressive images at the child's disposal?

Barnhart's (1942) ingenious study suggests that horizon lines are usually one of the last elements to be put into a child's drawing. Thus, a picture lacking clearly defining spatial indicators but showing otherwise sophisticated objects and relationships should be given a coding appropriate to the level it would have had had it been finished. (For whatever reason incomplete, a drawing was indicated as such in the coding notation.)

Where there are ground markings (e.g., game plans, paths, garden plots, etc.) on an otherwise blank background, it is assumed that the entire paper is intended as ground but that there may have been no time or desire to bother to fill it in with color. These drawings, too, were coded according to judgment of other elements and relationships. Coding based on other elements was particularly applicable to drawings from Greenland where snow and ice covered the entire terrain in most places at the time the drawings were made. Some children even complained that they were not given chalk with which to make the snow.

Drawings with very little information of any kind were placed in the most correct, yet highest category which could reasonably be inferred, e.g., if serious topological problems were in evidence in the drawing of the human figure, the picture could not be regarded as representing the cognitive level of a child ready to enter the period of concrete operations. If there were no important topological problems, but a well-drawn isolated figure was composed of mixed-view body parts, it would be considered as a transitional form still at the intuitive pre-operational level.

If, however, one or two single elements (devoid of any ground context) were nonetheless downward oriented and exhibited a consistent, well-understood true profile or correct, two-sided view in the case of a geometrical form, we would be forced to conclude that this was the work of an operational child, regardless of the artistic quality of the drawing or the limited number of elements available for judging.

One other type of "incompletion," where all elements do not appear to be coordinated into one continuous whole, seems to be related more to cultural or personality considerations than to purely cognitive factors. In India, for example, vignettes are common; in Hong Kong or Japan it is not unusual for partial figures to be represented at the paper edges (as though the paper were merely the focal point rather than the boundary definition of the scene itself); in Brazil we come upon many small baseline drawings arranged in a repeat pattern resembling a textile design approach; and in almost every country, some children will make a complete drawing way off in one small corner as if the size of the paper were too demanding.

Occasionally the paper is divided into two or more sections, and completely distinct drawings are present in each, either with different play themes or locations, or as time sequences. In this case the best completely integrated, or the most consistently repeated drawing style determined the coding.

Though these "incomplete" or "fragmented" drawings were difficult to judge, even more difficult were those drawings which could be called "mixed-responses," i.e., where both sophisticated and regressive elements appeared in the same drawing. Here the task was to sort out "learned" clichés which were merely copied without being understood, from those forms which truly represented a groping toward a more advanced level. The question arose, too, whether this phenomenon represents an advanced work with a few regressive schema drawn out of habit, or a lower level drawing showing a glimpse of experimentation toward a new idea?

A definitive answer to this question is difficult given only one drawing per child and no possibility of discussing the problem with him. Several approaches are possible. One can carefully examine all elements of the same or similar class to determine whether or not the immature one is an isolated case or represents an entire set which is undeveloped; or, one can determine whether or not the regressive element is merely a peripheral anomaly or one which actually negates the possibility of a firm, advanced

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contextual structure (e.g., a drawing may contain a number of well-drawn three-dimensional items, but if there is a vertical parallel-edged street at right angles to the base of the paper, it cannot be the work of a child who has internalized the idea of a plane). In cases where the dominant object of a set shows absolute clarity of thought but other members are given simple, schematic representations the possibility was entertained that time limitation or emphasis account for the lower level forms (e.g., the subject and his friend are drawn large, holding hands in the foreground, whereas the rest of the playground is filled with simple stick figures suggesting their position relative to the subject and friend but also their lack of importance), then we would examine the entire spatial setting and--if there were no other negating elements--code it at the higher level represented by the main figure, but not as high as the level in which realistic proportions are attempted.

These are some examples. In any event we were coding adjacent categories for the most part, so that possible misjudgment would involve only one transitional step rather than a leap by-passing an entire stage.

It is absolutely necessary to note here that humility and honesty demand acknowledgement of the fact that subjective error is possible and probable. Every effort has been made to minimize the incidence of incorrect judgment, but sometimes the limited information which can be gleaned from one drawing per child with no other form of communication or examination possible, creates problems which--added to visual fatigue attendant upon studying thousands of drawings--makes some misjudgment inevitable.

In order to be as careful as possible, "difficult" drawings were always set aside for discussion. We returned to them after each school had been coded and then, again, after the entire country had been coded. In this way we could see whether or not there were some overall stylistic approaches, architectural or environmental problems (e.g., snow in Greenland obscuring many ground indicators, unique playground equipment such as a simulated mountain with a tunnel through it in one Japanese school) which

could account for our lack of recognition at first and for some of the unusual representations. In most cases, photographs of the actual school lay-out were available and used as guides to correct interpretation of questioned elements.

Final coding of difficult drawings depended on agreement reached through meticulous joint examination and discussion.

Special Considerations Related to Sorting Drawings from Non-literate Societies

Although in drawings classification attempts at Stage III are generally related to spatial organizations such as "ground area/ sky area," "up/down," etc., other simple classifications begin to appear at this time and are given equal weight in assigning drawings to this cognitive level: sets of objects related by color, form, size, function, etc.

It was important to keep this distinction in mind when examining the Amazon Indian drawings where efforts to create visual, direction-oriented spatial organizations were extremely rare. However, a subtle conceptual ordering--based on the mythic categories of Mundurucu thought--may be revealed in their drawings. J. Hess, in A Structural Analysis of Mundurucu Myth (1972), suggests what some of these categories might be. Mundurucu myth associates males with the village and females with the forest, while the shaman takes up a mediatory position between them. Taboos tend to restrict female contact with water, represented in myth as the male fear that when women and water are in conjunction the women will have superior power. Hence fish and water representations should not occur together with signs designating women.

In addition to specific localities animals also have significant mythic associations: fish are linked with women (negatively, for men), the tapir often represents male sexual prowess and virility, birds and armadillos accompany the magic and changes of the shaman's mediatory zone, etc.

Many interesting questions are raised which require more information, familiarity with the meanings of design elements used by the Mundurucus, and more time to devote exclusively to this project

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in collaboration with Mundurucu specialists[1].

For the purposes of this study, recognition is made of these possibilities, but stage determination was made largely on the basis of topological relationships, Euclidean forms, degree of visual realism and individuality suggesting symbols rather than signs, and more obvious classifications where they appeared.

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[1] For more background on these Indians see the writings of Robert Murphy (especially 1958 and 1959) and Levi-Strauss (1967, Chapters 8-11, and 1969). Also, Nancy Munn's excellent study of Australian art, "Visual Categories: An Approach to the Study of Representational Systems" (1966) suggests one way in which a structural analysis of Mundurucu design elements might be attempted.

DRAWING CLASSIFICATION CRITERIA ACCORDING TO PIAGET'S STAGES OF COGNITIVE DEVELOPMENT

The following passage from The Psychology of Intelligence (Piaget, 1968, pp. 49-50) will serve to introduce the overall approach to examination of drawings in terms of Piaget's theory of development.

> Briefly then, the explanation of intelligence amounts to linking the higher operations with the whole process of development, development being regarded as an evolution governed by an inherent need for equilibrium. Now this functional continuity is quite compatible with the differentiation of successive structures. As we have seen, we may represent the hierarchy of response-patterns, right from the early reflexes and global perceptions, as a matter of progressively extending the distances and of progressively complicating the paths of interaction between the organism (subject) and the environment (objects); thus each of these extensions or complications represents a new structure, while their succession is dependent on the need for an equilibrium which must be more and more mobile as it becomes more complex. Operational equilibrium fulfils these conditions on reaching the greatest possible distances (since intelligence tries to embrace the universe) and the greatest possible complexity of paths (since deduction is capable of the greatest "detours"). This equilibrium is therefore to be regarded as the final limit of an evolution whose stages are still to be traced.

Although Piaget divides the growth of intelligence from birth through early adolescence into four major periods, the first of these stages is not included in the sorting categories because it lies completely outside of the possibility of representational expression.

These four major periods are: the Sensori-motor (up to 18 months or 2 years), the Preoperational (18 months or 2 years up to approximately 7 years), the Concrete Operational (7 or so to 10-1/2 or 11 years), and the Formal Operational (from 11 years on).

In the material which follows, the numbers given will indicate the basic coding numbers used in this study. Ages will merely suggest developmental time segments during which certain behaviors are anticipated according to data from Piagetian researches. Piaget would be the first to admit that these cannot be rigidly

applied because of the number of variables affecting the adaptive potential--or opportunity--within which each individual strives to experience his own moment of being in a given society.

The first of these periods is characterized by several developmental tasks, notably those involving perceptual and motor coordinations, permanency of solid objects, and constancy of perceived spatial qualities and relationships. Being basically motoric and involving practical perceptual organizations, this period of spatial manipulations is presymbolic, subordinated by and structurally inferior to the representations which characterize later stages and which are the special concern of this study.

During this early period scribblings--when they occurred--would involve only the challenge of hand-eye motoric coordination, contact with the paper, and delight in the sensation of this achievement.

Memory at this level would involve only recognition, not evocation. In other words, its roots are in sensori-motor assimilation related to action schemas and would operate only in the presence of an object already encountered on a previous occasion. According to Piaget, the onset of evocation memory (mentally recalling an object in its absence), the beginnings of deferred imitation, of ludic symbolism (make-believe play with objects becoming symbolic), drawing, and the start of language, all occur somewhat together and signal the transition into the next stage during which the semiotic function--manipulation of symbolic representations--begins to develop fully.

Pre-operational Period: Drawing stages I, II, and III

Throughout this developmental segment the child's basic stance is one characterized by egocentrism, lack of introspection, centering[1], transductive reasoning, and a dominating perceptual orientation to the interpretation of reality.

Nature--instead of a wondrous system of laws known and unknown--is dominated at first by what Piaget calls "diffuse artificialism"

[1]For a fascinating study of visual scanning in terms of gradual decentering, the development of object recognition and representation from ages 3-4 to 6-7, see Zaporozhets, 1965, pp. 83-101.

(Piaget, 1967, p. 371): all the acts of nature are controlled by man's will or--if not--at least they are done to, for, or about man. And for each child, this center, this "man" consists of himself and the significant adults in his life. Nature is the world from his point of view alone and social interaction is distorted by his ignorance of his own subjectivity[1].

Piaget divides this period into two sections: the Pre-Conceptual (ages 2-4) and the Intuitive (ages 4-7). He--and most researchers replicating or interpreting his studies--find that the Intuitive portion is further divided into a "lower" and "upper" (or transitional) level. Examining children's drawings also shows this same type of division.

Stage 1: Pre-Conceptual (ages 2-4)

In Luquet's terminology this is the period first of "fortuitous realism" and later of "failed realism" (or "synthetic incapacity"). Piaget finds this an apt description for--at the onset--the only discrimination which the child can make is the simple distinction between open and closed figures or that between a straight line and a curve. Images are only partial and fragmentary and are often mixed in with scribbles.

During this period and the next, the child's main task is one of understanding and representing topological relations. This is the basic geometry which Piaget finds precedes understanding of Euclidean and projective properties. Although he comments on the fact that sophisticated academic investigation of topological geometry is a later rather than an antecedent development in man's intellectual history, it does not seem so anachronistic if one considers the fact that some of the earliest prehistoric and archaic art finds are simple, quasi-Euclidean or topological forms with irregular open/closed and round/polygonal differentiations. Even the famous ancient mystic symbol of the Mandala is nothing but a basic circumscribed figure which, as Piaget says, should be a

[1] The relationship between social interaction and intellectual maturation is developed in an unusually satisfying chapter from The Psychology of Intelligence (Piaget, 1968, pp. 156-166).

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possible construction by the age of 5 or 6 years[1]. True, the rules for investigating this geometry did not develop until a later period in man's history but the simple poking, pulling, stretching, and playing with the properties of clay and other natural materials, the graphic attempts with a stick in the sand, and early markings on pots, baskets and other articles certainly preceded by far all formal operational abstract structuring of any unique geometric properties and relations, be they Euclidean, projective, or topological[2]. And we can of course only speculate with wonder at that moment when the earliest man-type creatures became fully upright so that their hands were completely freed for creative activity. So, in a sense, this is very consistent, for just as a child's first geometry preceding the period of operational thinking is topological in nature, so may have been mankind's earliest, basic geometric activity. And actions--for Piaget--are the basis for growth of intelligent, operational thought. In terms of vertical décalages (concepts reworked in various ways at different stages), this may be a case in which a hidden uniformity is variously expressed at different stages in the history of man. (We shall refer to lingering topological problems again when discussing Concrete Operations.)

At this very early pre-conceptual period of child thought, however, only those topological properties of proximity and separation can be recognized. In other words, emerging visual elements should no longer be enmeshed in random scribbles, and portions of elements belonging together should be placed in their approximate

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[1] See Kellogg (1969) for a very thorough examination of similarities between the symbols used by children, in prehistoric records, and in the cultures of present day non-literate societies.

[2] There are a wealth of informative books and articles on the subject of Paleolithic art. The reader may wish to examine Leroi-Gourhan's discussion of the stages in the "Evolution of Paleolithic Art" in The Scientific American, 218: 2 (February, 1968), pp. 58-70. There continues to be much controversy over the interpretation of tectiforms, claviforms, and various other non-representational signs found throughout the caves, as well as curiosity about little clay "sausages" and other "mobile" art of early times. See, for example, Ucko and Rosenfeld, Paleolithic Art (1967).

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locations while still generally retaining their separate identities. A human figure--when it appears--is likely to be no more than an irregular circle with two or more lines radiating from it. There may or may not be any recognizable "features."

Despite the effort to separate objects from their surroundings, however, transparencies will be common for quite some time to come. Because early drawings are based primarily on linear representations of open and closed forms alone, the solidity of fully crayoned surfaces or masses has not yet prevented the appearance of anomalous "see-through" portions of overlapping forms occupying the same space[1].

At this point the child cannot reproduce a straight line even if given the edge of the paper as a guide; measurement is related simply to "big" or "little" as an absolute based purely on perceptual impressions; he cannot imagine the relationship of a shadow to a light source, and, if asked to sort objects which belong together, he would arrange them in terms of sensory appeal, grouped in graphic or geometric display patterns.

As he gropes for more definite forms, basic Euclidean shapes (triangle, square, circle, and rectangle) will begin to be recognizable but only in embryonic form as somewhat differentiated closed curves.

Since drawing is--at first--an intermediate stage between play and the mental image (Piaget and Inhelder, 1969, p. 53) and since transductive thinking precludes the possibility that these somewhat scribbled, undifferentiated parts suggest a preconceived prior image, in the beginning the child is incapable of thinking in terms of analogies. In other words, if asked what he is drawing at the moment, he may name his effort merely to satisfy the adult, or, later, in surprised response to the analogy which is suggested by the finished product.

Later, as he moves from this "fortuitous realism" to "failed realism" ("synthetic incapacity"), his drawing may accidentally

[1] McCarty (1924) studied 30,000 children's drawings. She found that at age 4 more than 70% used only outlines. By age 8 60% used mass.

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suggest an analogy during--rather than after--the making of it, but he may still feel reluctant to name it until he sees how it turns out. He will continue to move from particular to particular, centering on one perceptually compelling aspect or event after another for quite some time to come.

INTUITIVE THOUGHT (ages 4-7)

Stage II (ages 4 to 5 or 6)

This lower level of Intuitive Thought is characterized mostly by exploration of those other topological properties known as order, enclosure, and continuity as well as acquisition of a sense of progressive differentiation between curved as opposed to straight-sided shapes. The child will begin to put "eyes" inside the head shape (enclosure) but at first he may not have them in the correct position relative to other features (order), for example, they may be sideways to the direction of the body or even below the nose[1]. Some of these problems of order are related to the fact that the child has neither any idea of the Euclidean concept of horizontal and vertical planes nor any external reference system whatsoever. Furthermore, because he is still centering on isolated aspects of the whole configuration, he is incapable either of considering relationships among parts or the relationship of separate elements to any larger context[2]. This is why, also, Genevan experiments showed that he was unable to reproduce layouts except in the form of crude proximities. Given the task of drawing from memory where there is no immediately present physical model to perceive and copy--where an internalized image is called for--he makes no effort to suggest an integrated representational area at all.

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[1]Although not examined in terms of Piaget's theories, Jacqueline Goodnow's paper on "Orientation in Children's Human Figure Drawings: An Aspect of Graphic Language" presents an interesting discussion of this problem of order. Goodnow and Friedman, Developmental Psychology (1972).

[2]Some of Piaget's most interesting experiments are related to these problems: the inability to imagine and draw the horizontal plane of colored water in a tilted bottle; the same problem with reference to a plumb line and the vertical plane of a tilted bottle;

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In terms of projective concepts, his inability to imagine a point of view other than his own, even when confronted with a three-dimensional model which he can walk around and examine, is dramatically exposed in Piaget's well-known experiment with the doll positioned facing a model at right angles to where the subject sits. He can neither draw nor select a picture showing the scene from the doll's point of view (Piaget and Inhelder, 1956)[1].

In addition, his efforts are further limited by his lack of ability to classify or understand serial ordering relationships. Before the child can realistically represent figures in a total spatial area, he must be able to sort in terms of "sky-things," "ground-things," "things which are rooted," "things which fly," etc. He must also be able to classify according to colors: "green, living plant things," "skin colors" vs. "non-skin colors," "cloud and sky colors," and so forth.

The younger child, still in the graphic collections stage of sorting, is logically indiscriminate, and colors or arranges things according to whim and pleasure[2].

Furthermore, there will be no effort to suggest texture in these early drawings because categories of "smooth" and "rough" things cannot be incorporated into his drawing schema. In the early stages, too, forms are so undifferentiated that it is difficult to tell a flower from a tree, a boy from a girl, etc. When he does begin to develop a sense of differentiation, it takes the form of stereotypes which are used whenever a particular element is

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matchstick posts planted in a model of a mountain placed at right angles to the mountain rather than in relationship to the table surface; etc. (Piaget and Inhelder, 1956).

[1]See also an updating and revision of some of these experiments in The Development of the Concept of Space in the Child, Laurendeau and Pinard (1970).

[2]Of course this inability produces drawings which are often aesthetically charming and very pleasing to adults. During the period of formal operations such color choices will be made deliberately to create certain visual and expressive effects, but at this point one cannot attribute "incorrect" coloring to conscious artistic or cognitive choices.

called for[1]. However, he does not understand the concepts necessary for logical classification--those properties which are held in common as well as those which are specific. Therefore he may have one or two idiosyncratic schemas for "treeness" but all trees are drawn pretty much the same way, without variations, in accordance with the "tree" schemas in his graphic vocabulary at the time.

During this stage he assembles and reassembles these schemas, mixing colors and objects with joyous abandon, giving no thought to visual realism or incongruities.

Since he is incapable of serial ordering, he is also unable to deal consciously with proportions. He cannot think in terms of "the school is taller than the tree," "the tree is taller than the child," or "the child is taller than the flower." He is also incapable of making one-to-one correspondences except by trial and error, so that establishing the size of one kind of element does not imply consistency in rendering corresponding elements approximately the same size as opposed to other, different elements.

He will have difficulty with the topological property of continuity in his drawings for some time to come. As a matter of fact, it will not be fully comprehended until well into the period of formal operations when the concept of "infinity" becomes operational and when, for example, a vanishing point can be understood and used.

At this early period he will draw the continuous as discontinuous and evaluate the discontinuous as continuous. The example usually given is of a hat floating above the head instead of on it. On the other hand, if he were to draw three flowers close together, he would undoubtedly tell you that there were fewer flowers in that spot than along a different line where he had drawn three flowers farther apart, because he could not see that the number is constant regardless of the amount of space they occupy or the distance separating them. For him it is "connecting" space rather than

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[1] See Kellogg (1969) for a very thorough cataloging of these classic schematic representations. Examples can be found throughout the art education literature and are remarkable for illustrating the consistency with which such forms are used throughout the world. See also Read, Herbert, Education Through Art (1945).

"separating" space, hence the illusion that "big" space must be made up of a "big" number of things.

Another example of these kinds of problems is the following: if the child were to try to draw a building which in actuality had a rigid alignment of equal numbers of first and second floor windows (with the possible exception of a door), he would feel quite content to spread out a few large ones on one floor and many smaller ones on another floor. They would be "equal" enough to suit him because they occupied the same amount of space on each floor and because he is not concerned with correspondences.

Because of his perception-based thought he also imagines that area, volume, and length or height change as the shape of the object or its container, surround, or placement is changed. In terms of spontaneous drawings rather than experiments involving specific isolated tasks (as in Piaget, Inhelder, and Szeminska, 1960) one type of example of the above confusion might be the following: a picture in which a child is drawn very large in open space (a "container" bounded by the paper edge) could also show his playmate at the same time as very tiny because he is inside a different size and shape "container" (here, a house or school). The fact that he and his friend are the same size and should thus be drawn the same regardless of how much room is available, does not occur to him[1].

Luquet describes this period that the child is entering as one of "intellectual realism" and it becomes firmly established by the time he reaches the upper level of the Intuitive stage.

The basic egocentrism mentioned earlier persists throughout both levels of the Intuitive stage and will continue to dominate the child's stance toward reality, interfering with the possibility of recognizing or coordinating different viewpoints or of drawing in terms of any kind of perspective. Consequentl he will continue to be unable to imagine the cross-section of objects at all, but

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[1] Of course this is not identical to the experiments with various size containers, etc., described in Piaget, but it is related in such a way as to suggest how spontaneous drawings can be a cue to cognitive problems of a given stage.

may delight in showing both the inside and outside at the same time in what are known as X-ray drawings. Because he pictures only those important conceptual attributes of objects which have contributed to the build-up of an internalized image, he continues to draw without concern for visual realism. Since his interpretation of his work is still analogical, he is not at all disturbed by omissions and distortions of reality.

It is interesting to note that Piaget finds this time also that of "mythological artificialism." Though the child may no longer see himself and other humans as the controlling force in nature, he does try to supply his own answers to or resort to fairy tales for explanation of his newly posed questions about those natural forces and their origins: ". . . Diffusion gives way to more sharply defined conceptions in the form of myths" (Piaget, 1967, p. 132). Suns with faces, animals holding flowers, fairies, all sorts of fantastic and unexplained elements appear in pictures at this early age. This probably accounts for some of the delight with which adults view some of these charming creations, and for their disappointment when children turn away from the mythological and intellectual representations they have constructed from the internal images and imaginings of their own minds and attempt to structure their representations through the use of logical operations and external visual cues.

Finally, throughout this entire period, Piaget's experiments show that images are static, basically incapable of expressing motion (Piaget and Inhelder, 1969). This is also a characteristic which is classically attributed to this general stage by every major study in the history of art education. These stylized figures are frontal (facing the child who chooses to see things as relating to him, and in the position giving the most information) and the relationship of body parts is based on vertical and horizontal extension, or the greatest contrast of direction[1].

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[1]See Schaefer-Simmern (1948) for an excellent discussion of stylistic changes with regard to elements of expressive mobility.

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Stage III (ages 5 or 6 to 7)

This is the upper level or transitional portion of the Intuitive period of Pre-operational Thought and Intellectual Realism. Until now the child has not been concerned with visual or logical incongruities and has been satisfied with trial and error solutions to problems. At this point, however, he shows signs of discomfort with this approach, declines in analogical interpretations, and moves toward increasing realism and detail.

In various experiments he may come up with the "right" answer by intuiting what is correct based on his many trial and error "solutions" but when pressed for reasons, will still display pre-operational thinking and give psychological causes rather than logical implications. Piaget finds that the inability to understand these implications, also, the retention of purely psychological causes, is why six-year olds cannot see the inverse relationship between the conjunctions "therefore" and "because." According to Copeland (1970) this difficulty is called "juxtaposition" and is also related to the topological one of order and, of course, is in evidence at the same time. By the time the child leaves this stage, he will have resolved almost all of the basic topological problems in representing the human figure although, as the possibility of new views (e.g., pure profile) occurs, new problems of ordering may appear[1].

The child's basic "vocabulary" of Euclidean forms is now complete and available for development and combination with an emerging idea of projective changes in objects and in the recognition that the form of a cast shadow will depend on the light source instead of or his point of view. He will still make only guesses, though, as to the correct form it will take. His sense of Euclidean relationships, however, is still confused and very immature.

As mentioned earlier, he has no difficulty copying a circumscribed figure by the age of 5 or 6, nor does he have trouble

[1] An excellent study of human figure drawings by children aged 13 months to 6 years is found in Joseph H. Di Leo, MD, Young Children and Their Drawings. Of special interest is the division of the book into two sections: the usual and normative and the unusual and deviant.

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differentiating polygons based on the number of angles, noting dimensions differentiating a circle from an elipse, or mastering the rhombus. He also begins to approximate the idea of a straight line between two points when he has a model to follow.

He now has many of the practical tools he will need as he gropes for more accurate visual representations. The transitive property of equals slowly begins to be understood so that he should become more consistent in judging the sizes of like objects and in duplicating parallels accurately (as in a series of windows, for example). Although actual measurement is not possible at this time (and would rightly be discouraged in connection with drawing as creative expression, though of course necessary at a later date when studying the techniques of accurate perspective rendering), the general notion that some element in the picture can be used as a rough standard is necessary for development of a visually coordinated whole.

With the conservation of number which comes at about this time, there is an additional aid to development of accuracy in representing the number of elements belonging to or fitting into one given space or container as compared with another. As they leave this transitional stage children will begin to care about the actual number of stairs leading up to the door of the school building or how many desks fit into one space as compared with another. (It is fascinating to note how elements will be squeezed into areas to make the number of objects begin to come right even though not enough space had originally been allotted for them.)

Most important is the fact that number constancy--regardless of the size of the container or arrangement of objects--is necessary for the development of seriation, classification, and numeration which is about to become operational soon. Piaget feels that the development of numeration and logic are concomitant: " . . . both types of ability derive from an internalization of the child's classificatory and ordering actions that become an integrated set of mental operations with logical characteristics" (quoted in

Elkind, 1964, pp. 275-296)[1]. Without these operational skills, of course, future efforts at coordinating perspective, proportion, and distance would be doomed to failure.

Despite this growing sophistication, however, his efforts are still thwarted by clinging perceptual ties and persisting intellectual realism. For example, although he can readily distinguish a circle from an elipse and reproduce each accurately in a drawing, he cannot draw a circle as an elipse even when it is demanded from his own point of view because he knows it is a circle. Similarly, he can clearly see and admit that train tracks and street curbs appear to converge at the horizon, but he must draw them as parallel because he knows them to be parallel.

For the first time, he really tries to construct a layout from a model, but although he may try to use two or three reference points simultaneously, he cannot make a coordinated whole because he still has no notion of an external horizontal/vertical reference system. Although he may try to use what is known as a "Personal Reference System," he cannot even do that with accuracy because he does not understand the logical demands of the "Brother Relationship" employed in "to the left of, to the right of, in front of, behind," etc., as they refer to coordinated placements.

Though he begins to differentiate between different points of view he cannot coordinate them into coordinated perspective either, because he is still subject to perceptual error and is not yet freed from his basic egocentrism.

However, a new element has begun to emerge which will help him in his developing efforts to represent objects in some kind of realistic spatial context. He no longer "scatters" objects on a page as he did earlier during the "graphic collections" style of

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[1] See, however, P. C. Dodwell (in Sigel and Hooper, 1968, pp. 104-113) for results of a study, considerations of which ". . . lead the author to believe that an adequate picture of the development of logical, numerical, and other concepts will only be attained by intensive longitudinal study of individual children" (p. 112). Dodwell used only 60 subjects.

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sorting and arranging. He now attempts to classify objects according to simple properties such as size, shape, and color. He also begins to classify in terms of grouping things which belong together spatially. These groups begin to form a rudimentary realistic frame of reference: the bottom edge of the paper begins to represent "down" or "where the ground is," and the top suggests the area "where the sky is." A partial or thin base (ground) line may or may not be present, as may also a thin strip of sky. However, these are not at this time functional spatial areas except as they designate boundaries, for they are only schematic representations correctly placed in terms of the topological property of order. Because the property of continuity is not fully developed, sky does not meet ground, nor do objects stand on the ground line; rather, sky and earth-bound objects alike (movable and stationary) float in the intervening space. The creation of a continuous ground space will be one of the major representational challenges of the period of concrete operations for which he is now preparing. This can take a different form from the one just described depending on the cognitive/affective predilection of the child. Until they can understand and create a plane, all children are confronted with the same general dilemma: ground areas will be represented as a plan whereas objects on the ground will be drawn in elevation.

This incongruity cannot be resolved until the abstract idea of vertical and horizontal as constant, coordinated referents in external, three-dimensional space becomes fully operational. For the present, however, though no functional ground areas exist, these transitional drawings begin to show the immanence of one of three styles of spatial organization to be developed in the ensuing period:

(A) Those which divide the paper into sky and ground areas and in which this division ultimately will become the horizon, the important horizontal boundary referent to which all objects below will relate. Since at least a part of most objects is already drawn in elevated form, the basic vertical/horizontal structuring is somewhat implicit, and the

common phenomena of fold-out and fold-in are not too often present. However, horizontal surfaces on objects (table tops, etc.) will be drawn in plan form for some time until the inconsistency of multiple views of a single object is recognized. Ground areas such as game layouts, playing fields, ponds, sand boxes, etc., will, on the other hand, continue to be drawn in plan form until a simple plane is devised.

(B) Those which consider the paper edge as the spatial boundaries, with all the enclosed area representing ground. It appears that some central point or localized area becomes the important spatial referent with all distances and relationships directed in toward it from the edges or out from it to the edges. As would be expected, it is in this style that problems of fold-over are most evident.

(C) Those in which no effort is made to suggest extended space, in which the child is content to line up all action and suggest relationships along the bottom of the paper or upon a simple, undeveloped base-line. When this choice is made, stages of development are evident only through the correctness of proportions, the accuracy and detail of representing objects, the liveliness and expressiveness of figures and their relationships, the use of true profile or three-quarter views, and the general effort to begin to suggest three-dimensionality within a limited context. The potential for spatial challenges are few, so errors are less frequent. This does not appear to be a separate cognitive or affective style so much as an option available to children using basically either one of the other two main approaches.

As mentioned above, these are the styles which seem to be emerging during the transitional segment of the Intuitive Stage. (Indeed, there are even earlier glimpses of this general orientation.) However, at this point, no functional ground is actually represented, and this later developement is only suggested now by

the spatial orientation of object groupings[1]. Regardless of the style adopted, all three types of drawing show the same stage-specific characteristics and sequential development which ultimately culminate in the rich potentials of the stage of formal operations.

Objects within these settings, incidentally, also begin to show preparation for the next stage in which, according to Piaget (Piaget and Inhelder, 1969), they lose their static quality and become kinetic in representation. In order to show mobility (action of joints, etc.), however, a profile view is necessary; this is as yet beyond the capabilities of the child who has only recently resolved basic topological coordination in terms of static, frontal figures. He therefore combines views, using the most characteristic aspect of each portion to create a figure which is intellectually satisfying to him for the moment but incorrect from either point of view by itself. The result is very much like Egyptian art or the deliberate free juxtapositions found in some of the works of various modern artists.

If he feels free to show front and side views at the same time, of course he can also show inside and outside at the same time so that X-ray pictures (mentioned earlier) are not uncommon. Because he does not yet understand the principle that no two bodies can be represented as occupying the same space[2], he feels free to "overlap" on the same stand line without allowing space

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[1] It is beyond the scope of this present work to investigate the explanation for the appearance of these two basic styles: they may be related to Lowenfeld's separation into Visual/Haptic personality styles (see Gutteter, 1972, pp. 15-23); to Witkin's Field Dependent/Independent perceptual styles with all of their concomitant personality variables such as authoritarianism (see McWhinnie, unpublished MS., date unknown, 1969 or later and Kensler, 1964); an anlytical vs. global approach to thinking (see among others Barron, 1969, for an overall summary of creative vs. non-creative styles); and perhaps to the dominance of either accommodative or assimilative behavior, to use Piagetian concepts.

[2] See Boener in Williams and Herman, Eds., "Evaluation of the Grade Placement of Science in the Early Elementary Grades," Current Research in Elementary School Science, 1971, especially pp. 30-31. This study uses drawings in the testing instrument.

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between the "overlapping" elements. Consequently, this is not true overlapping (anymore than an X-ray is a cross-section) because Euclidean spatial relations have been ignored.

Concrete Operations (ages 7 to 10-1/2 or 11)

Since this stage covers much of the development going on during the elementary school years, it is not surprising to find it complex and intriguing. It is generally broken down into two levels with the onset of hierarchical classification and the idea of vertical/horizontal coordinates (usually around age 9) signalling the transition between the two.

This did not seem quite adequate in terms of the many challenges and attempts at solutions which characterize the child's efforts at graphic representations during this period. As a matter of fact, although Piaget uses drawings extensively as examples of spatial development during the Pre-operational period, he does not seem to give as thorough attention to spontaneous drawing behaviors during the period of Concrete Operations. When he does, his attention seems to be turned more to individual objects and relationships within them, to copying from models, or to isolated tasks using graphic representations as a convenient device for examining some other problem of interest, than it is to examination of the problem-solving inherent in the task of creating spontaneous drawings coordinating elements within an entire spatial context[1].

There is no question that somewhere around age 9 visual realism is established, along with reversibility of thought in virtually every aspect of the concrete structuring of reality. There is great unanimity in the observations of art educators establishing this age as that which heralds the development of interests and skills allowing for more literal graphic representations.

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[1] Even the very related task of drawing a copy of a model layout is judged basically in terms of measurements within a Euclidean reference system of coordinates. The problem of manipulating internalized images and relationships from memory seems to be given little attention in terms of demands on the intelligence in the act of graphic creation. In this context the reader will want to look at Piaget and Inhelder, et al., Mental Imagery in the Child, Basic Books, Inc., N.Y., 1971.

However, the several years before that point has been reached are usually regarded as a stage marked by the child's discovery that he is part of a very real physical/social environment. In response to this discovery he is forced into recognition of the incongruities and inadequacies of his earlier simple schematic solutions. This is completely consistent with the description of changes taking place during the early stages of concrete operations (age 7 or so) according to the findings from Genevan experiments. He now turns away from the manipulation of schematic representations and begins the structuring of immediately present reality in terms of two types of logic: the logic of classes and the logic of relations.

Stage IV (Lower half: up to age 8)

It is significant that this is the moment when the child turns away from Mythological Artificialism and adopts a stance which Piaget calls "Technical Artificialism" (Piaget, 1967, p. 371). With his growing awareness of an expanding environment peopled with a wide variety of "others," he begins to question those early explanations which were merely constructions of his own freely creating imagination. Now, natural causes become mixed with lingering artificial explanations.

This is the time when introspection begins, when he can attempt to retrace his thoughts as the first step leading toward the ultimate establishment of fully reversible thought. Along with this new questioning he begins to show evidence of a decline in the egocentrism which had so completely dominated his earlier cognitive and social functioning.

As he begins to realize that each object has several properties, that there are a number of variables to be coordinated in each problem, he no longer centers on one particular aspect at a time and gradually becomes dissatisfied with the multiple and contradictory formulations which were the inevitable consequence of such centration.

Recognition of points of view other than his own is--of course--concomitant with all of the foregoing developmental changes.

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However he still cannot coordinate them into a total reference system although for the first time he begins to make a serious attempt to do so (Piaget and Inhelder, 1956). He will still have trouble making a drawn copy of a layout (Piaget, Inhelder, and Szeminska, 1960) but will be able to incorporate all the objects displayed in the model, showing approximate groupings. He will still be unable to compare positions and correct distances simultaneously.

The first of these problems is of a projective nature: the child is just beginning to adopt the "end-on" perspective sighting to establish a straight line made up of separate elements. When he discovers that he can best evaluate its straightness from this position rather than from another (or by attempting to align it with some contextual "given") he has begun to internalize the idea that appearances change depending on position. In addition, this type of "end-on" perspective construction forces acceptance of the fact that all like elements standing behind the first one will become invisible when the alignment is perfectly straight.

Eventually this notion will lead to the use of overlapping in drawings as the child discovers that different portions of various size objects will become obscured, depending on their position relative to one another and to his point of view.

At this stage, however, although he recognizes that appearances change from different points of view he is unable to represent his own viewpoint adequately because he is not consciously aware of the fact that he and the objects depicted both occupy the same projective space[1].

Despite his efforts at this time, he will not be able to integrate perspective elements in his drawings until the idea that objects are located on a Euclidean grid of vertical and horizontal coordinates becomes operational. His inability to copy a layout accurately at this age indicates that this concept has not yet been established even though he has been able to make some good

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[1] Langer, S., Feeling and Form (1953), Chapter 5 on Virtual Space, pp. 69-85.

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approximations whereas earlier there were only trial and error guesses as to placement.

His main drawing task at this lower level of concrete operations is directly related to these unsolved geometric problems. At the end of Stage III he was beginning to group spatial objects together; now he is trying to locate them in a continuous ground context.

The classic drawing at this time is the simple (C) type in which all objects are lined up on a clearly drawn ground line. Often these are represented in mixed views, but earlier, frontal, and later profiles and three-dimensional views can also be represented in this kind of spatial organization. The sky in early forms is often just a strip at the top of the paper, but all elements present are apt to be found in their appropriate natural area.

Because the child is experimenting with "end-on" sighting, he may show one object standing "in front of" another, but (as discussed below) they all occupy the same stand-line and so cannot truly overlap.

Quite often these pictures display an extraordinary sense of balance; either a grouping on one side will be countered with a large empty space on the other, or there will be a very precise symmetry achieved through use of, for example, a tree on each side with other elements centered between them (two girls holding a jump rope while a third in the middle is poised in mid-air, jumping).

It is interesting to note that conservation of distance, length, and area is established by this time. Experiments for the first of these (Piaget and Inhelder, 1956) involved for the most part distance along a linear dimension between two end points. The two cognitive operations determining success were: a) the distance between the end points remains the same whether or not any portion of the total space is segmented by a barrier or in any way filled, and b) the distance remains the same regardless of the direction of travel.

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Conservation of length was established when the child recognized that a) an altered line (or) was not the same length as a straight line (———) covering the same distance between the end points and b) that the length of equal objects remained the same regardless of the projection of one of these beyond the end point of another (and).

Area is conserved when the child realizes that two identically bounded spaces contain the same amount of unfilled room regardless of the diverse arrangements of equal numbers of equal sized objects dispersed over their surfaces.

The clear interrelationships among these conservations and their mutual dependence on the kind of logical thought which made conservation of number their predecessor, constitute a beautiful example of the comprehensiveness of Piaget's theories which makes their study so intellectually and aesthetically satisfying.

It is significant to note that order should already be established by now and that the topological property of enclosure develops fully at this time. Only continuity remains unresolved (we shall return to this later).

We can try to examine the simple, "classic" base (ground) line type drawing of this age in terms of the conceptual growth just described. First of all it is possible that this balanced "framing" of the base line with trees, etc., when it occurs, may be a subtle expression of the child's recent full development of the property of enclosure. In a sense he is making an effort to enclose an entire two-dimensional segment of reality rather than merely to concern himself with the properties of a single element. In this effort we can see an example of the decentration which is an important aspect of growth during this period. It is also an example of an interim stage of a vertical décalage in that a more sophisticated form of enclosure will characterize his spatial organization of a space cell at Stage VI and again be evident in the creation of aesthetically satisfying compositional form in adolescence.

At this time enclosure may still show some errors related to mixed views (for example, transparencies) but will no longer show

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those connected with Stage III in which the bottoms of houses, trees, etc., were enclosed and thus floated above the unused, schematic "ground" or paper edge. This is partly due to the fact that the property of continuity was still undeveloped except as it pertained to portions of individual objects.

When these elements were enclosed in that way the child could make one element seem taller than another simply by placing it higher up on the paper than the first one. Now that he has learned to conserve length and place things in a correct and continuous order on a ground, he will ultimately be forced to consider relative proportions; and he is now developing a new conceptual tool to do just that, for serial ordering operations begin at around age 7.

His recent mastery of order is evident in his effort to line up elements along the base line in correct relationship to one another--where they "belong." He will also try to "arrange" correctly his friends on a jungle gym and to place flowers in a window box under a window, one on each side of a door. With serial ordering he should also begin to see and correct gross incongruities in terms of relative sizes along this simple linear dimension, where they can easily be compared and generalizations can be made. All of these operations are assisted by his improved sense of measuring in terms of a standard.

This consistent though simple base line organization also shows other evidence of the development of these conservations. Transitional drawings quite often showed a ground line interrupted by a building which was standing not on the ground line but on the bottom edge of the paper. Curiously, the ground line on one side of the building may have been much higher than the other, or completely nonexistent despite the fact that flowers, etc., might "grow" out of the bottom of the page (i.e., it was not simply an uncompleted picture).

First of all, it appears that initially the child was not concerned with the continuity of the ground surface. Furthermore, even though he could perceptually recognize the Euclidean property

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of parallelism, he could not operationally conserve the equal distance between parallel lines when they were interrupted by a vertical (here, a building). Eventually the operational child would begin to recognize this logical necessity. Furthermore, he would gradually move from centering on one part of the ground line at a time to begin to organize the picture as a whole.

So far we have been describing development of the most simple form of spatial arrangement which is used when the child first enters the period of Concrete Operations. We mentioned earlier that when the child tried to represent extended space, the problems became more complicated. In the (A) type drawings, he continues to use this same linear organization but in order to show more areas of activity he may use more than one such alignment: he piles them one on top of another in Egyptian-type registers. It is not unusual to find a sun, clouds, or birds under the second or third such ground line. Here again, the property of continuity of ground has not yet become operational except along the horizontal dimension.

Sometimes, in a hold-over from Stage III when he simply drew along the bottom edge, he will start by placing objects there, then realizing that he should have a ground line, he will fill one in behind. Occasionally, other objects are then placed on the top of this shallow stand line creating the illusion of overlap where there is in reality merely a transition--or recovery--from a more immature spatial style. Often pictures of this type display early transitional forms in the figures and other objects portrayed which is, of course, a clue to their undeveloped nature.

When a ground line is drawn first, this ersatz "overlap" rarely occurs. However, another possibility does arise: if this deliberate ground line should be placed a bit higher on the page, then space is created below it. Roots, stairs, partial walk-ways from the house, reach down into it from the surface, indicating that, at first, it is still not seen as near and far, but more as a combination cross-section and simple plan. With the discovery that this is usable space and not merely a stand line, raising the line becomes a possibility, creating the semblance of a horizon

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upon which and below which objects can be arranged.

In the case of a registered drawing such as that described above, the same basic simple organization is achieved when the child recognizes that there cannot be two suns in one continuous scene. He may then try to connect these two linear areas by drawing a road, or he may merely scatter more "ground" elements, such as flowers, in between.

The final result in either case is the same, and a spatial area is thus created which can ultimately contain a foreground and background. At this point, however, because he still is unable to coordinate perspectives, he has not created a plane nor overlapping figures and is only drawing with a two-dimensional mixture of plan and elevation. Occasional fold-overs may occur as with trees lining a road which is vertically drawn, but the general horizontal orientation of these types of drawings causes these problems to be avoided more often than resolved at this time.

In (B) type drawings using the entire page as ground area, the child will make the following kinds of incorrect organizations. (1) He may (especially in game plans) use both sides of the paper as reference points instead of horizontals as in (A) drawings. In this case all objects will fold in toward the center line. Since he is only guessing about the center and positions relative to it he may need to crowd the players on one side or not draw the full team. Goals, players, ground markings--all fold inward. Conversely, he may (2) use only the center line as his reference point. Then the problems are similar but all figures will fold out to the sides. (3) Occasionally he does not relate movable figures to the "base" of only one half of the layout (whether this is the side edges or the center line), but will relate members of each team to the total space in terms of the direction of the opposite goal. Thus, players which appear on the same side of the center line have different orientations: some fold inward and some outward. Though this appears to be less organized, it could possibly be intended as a more realistic representation of team interaction during the actual moments of play.

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This may be related to Piaget's experiments (Piaget and Inhelder, 1969) from which he concludes that during the period of Concrete Operations images lose their static quality and the child gradually becomes capable of representing transformations. However, first he must be able to draw kinetic changes--movement of the object from one position to another.

Before one could make this assumption about a drawing such as (3) described above, one would have to have a prior drawing such as (1) or (2) to determine if the child were actually depicting a change of position or whether he merely drew within a totally disorganized spatial context. There are some clues though, which, given only the one drawing, can help with making this evaluation. If the figures themselves show a lively quality (attempt at profile or joints, reaching, etc.), if the markings on the field show an almost "measured" regularity, if figures show an approximate uniformity of size, then it is likely that this drawing is not confused, but instead shows the development of kinetic imagery.

The last of this type of game plan organization to be discussed (4) still shows a combination of views, but a less serious problem in terms of resolution when three-dimensionality becomes a logical possibility to the child. In this case, the playing field is represented in a plan, whereas the figures are drawn in good elevation and are all downward-oriented. Here again, the kinetic quality of the figures will suggest readiness for a more advanced level of development.

So far we have been discussing problems of organization within the area of a given, structured game plan. Suppose the child wishes to incorporate this playing field into an entire layout. When he limited the problem to the boundaries provided by the game's ground markings the property of enclosure was simply expressed and continuity within the area was "a given." Now he has a new problem. He may call upon the simple, classic base line organization and merely stand the playing field on the ground line with the opposite side reaching up into the air, or he may place the field somewhere on the page and arrange other elements around

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it in an attempted layout of the entire area. In this case he may color in the rest of the background or try to suggest continuous ground by use of paths and other ground-line divisions. Without a horizon, though, he has difficulty fulfilling the demands of spatial enclosure and always runs the risk of creating drawings that resemble Stage III arrangements.

Similar problems occur when extended space is attempted where there is no game plan, but merely small groupings of children, say, around a piece of playground equipment. Early drawings show these elements floating above the used ground line where the basic organization occurs. Here again, the development of the property of enclosure and the discomfort over the lack of continuous ground cause the child to fill in the area surrounding the floaters up to the top of the paper, or to an enclosing but unused pseudo-horizon.

A fascinating attempt at an organized structuring of the ground area occurs when the child establishes a north-south-east-west map-like layout in which all objects find their relationships with reference to a central point. The child himself may be the locus, or an important landmark such as the school or his favorite game plot or piece of playground equipment. This approach usually results in an island-type arrangement on the page.

These (B) drawings will eventually lead to an aerial type of perspective, so that relationship to ground areas and markings are more important than relationship to a horizon as in (A) drawings.

Regardless of spatial style, at the conclusion of this lower level of Stage IV, the child has finally tried to create a correct ordering of elements within an enclosed (or defined) continuous (or connected) ground area. Though this area is not yet one establishing a foreground and a background, it does at least indicate an area plan in which direction from top to bottom in the layout generally corresponds to up and down in the real world.

Even in the last type described, though the child may draw in terms of compass directions, he will gradually move toward recognition that these referents can establish section guides with which he can more accurately plot the positioning of downright, ordered elements. But this will not occur until later.

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Stage IV (upper level: ages 8 to 9)

As he enters this phase the child has achieved conservation of all properties except weight, volume, and the topological property of continuity. Although conservation of interior volume begins now, the important concept of the physicist's "occupied volume" must wait for several more years. Measurement during this period becomes fully operational based on immediate insight involving coordination of the operations of subdivision and substitution.

The child can understand that his piece of drawing paper represents a given visual area which has consistent directional boundaries and distances regardless of how empty or filled portions of it have become. He can recognize how an object would look to an observer in another position and he can make an "end-on" sighting of a projective straight line which creates the possibility of elementary perspective.

It is elementary exploration of these relations plus the beginnings of a rudimentary logic of implication which characterize the main advances of conceptual possibilities during this next phase of development.

We must remember that the child's drawings are beginning to show correct downward placement within a continuous two-dimensional context and that individual objects can show kinetic imagery. However, spatial organizations all show discontinuity of viewpoint in that the ground is represented in plan while the individual objects displayed on that ground are shown in elevation.

We have here two sets: ground elements (horizontal) and objects standing on the ground (vertical). Until the child has reached the age of 9 or 10, he cannot deal with the formal understanding of logical connectives of "conjunction" and "disjunction" related to these sets. At this time he is operating in terms of an impossible intersection of sets because he has not yet reached a coordination of viewpoints such that he recognizes that elements within a picture cannot be shown both in plan and in elevation. Conversely, he does not realize that he is faced with a union of sets such that elements of his composition must all be in elevation or in plan.

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We are really dealing here with the beginnings of deductive logic because we are implying the connective "if ---, then ---." This kind of reversibility is about to become operational but in terms of drawings, seems to be dependent first of all on sophistication of "end-on" sighting and kinetic imagery.

As images come to be conceived of as retaining their identity while being moved to a different spatial location without altering that space, the child must deal with an intersection of sets (as mentioned above). On a very simplified level this first involves two-dimensional overlapping. In early drawings the child drew a game plan and placed a static figure within or next to it. As he recognizes the possibility of moving that figure to a different location during the action of play, he must cross lines and boundaries (the very definition of the game--and definition is also becoming a new skill). Drawings at this age now show overlapping of these ground lines in games, or of roads and pond edges, as the child conceives of the movability of figures.

With the idea that representational space is something which can be traversed, objects can now also be moved up and down in terms of the horizon. Thus we have a new intersection: objects below the horizon with objects on the horizon.

Eventually, as the idea of "end-on" sighting becomes more firmly established together with consistency of viewpoint, the child must recognize that portions of some objects must displace visibility of portions of those objects or areas behind it. At this point we have two-dimensional overlapping of both verticals and horizontals.

Until, however, the basic Euclidean concept of intersection of vertical and horizontal coordinate axes becomes fully operational, there will still be no representation of a three-dimensional plane.

Much earlier we mentioned the fact that the topological problem of order in the human figure should be resolved by the time the child left Stage III. Although this was true of the challenges of a static frontal or schematic mixed-view, it was not true in terms of representing the kinetic possibilities of a profile-view figure. At first both arms may come from the same side of the

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body and the side view of legs may divide at the center of the torso; joints may bend in the wrong direction and jumping feet may go backwards.

There is a poignancy to these errors which makes one pause after his reaction of amusement. Were the child content with the static, the inactive, he would be safe and correct. It is important at all stages to keep in mind the fact that these incongruities represent groping--growth.

Now, however, with the beginnings of the thought leading eventually to the logic of implication, the child can begin to recognize that if the figure he is drawing is facing to the left from his point of view, then parts of it must not also be facing to the right or forward. He begins to recognize the need for a consistent point of view and to learn the relationship of parts to the whole. He is now ready for the next stage.

Stage V (ages 9 to 10 or so)

This is the point in Concrete Operations toward which all prior development has been aiming, and it is also that which provides the logical structures upon which the adolescent can build when he moves into the final period of Formal Operations.

We have tried to suggest the dynamic quality of the changes which have taken place as new ideas have caused discomfort with the structures which had been accepted in earlier solutions. The unstable equilibrations attained at former moments now reach the possibility of increasing reversibility. That is, thought has become sufficiently mobile for the child to coordinate more of the drawing elements into a consistent whole.

In terms of drawing, at this stage he is capable of seeing the important relationship of objects to their surroundings now that the abstract idea of horizontal and vertical as a constant, external reference system in space becomes completely operational.

With this discovery visual realism becomes finally established. The child now makes efforts to coordinate perspective, proportion, and distance[1].

[1] See Shantz and Smock in Sigel and Hooper (1968, pp. 158-163)

With conservation of direction through understanding the principle of the vectoral straight line, he can recognize that he and the objects he is drawing are all part of one continuing perspective and hence he can, for the first time, represent a true, though simple, undifferentiated plane upon which three-dimensional elements can be displayed in a consistent natural setting[1].

With this new ability to see relationships and to structure space in terms of an external frame of reference, solutions to most other drawing problems fall into place. It is not surprising that the child now comes to believe that nature is the cause of everything, a developed attitude which Piaget labels "Immanent Artificialism" (Piaget, 1967, p. 371) claiming, however, that the child still clings to a waning egocentrism in that he nonetheless believes that everything is done for man.

When he starts a picture now he already has an overall plan in mind according to which all objects are arranged. We may remember some of the difficulties he had earlier in (A) and (B) type drawings when he was struggling to establish a continuous ground. In their current organized form we may see them as related to formal reference frames as described in Relative Position and Motion (SCIS, 1972):

> Personal Reference Frame. This uses the individual as the starting point, and direction is related in terms of left, right, front, and back. It is just at this time that the child has been able to understand correctly the reversibility of these relationships. Early drawings often displayed confusion in this regard: objects were rendered as if the child had turned the paper around (in his imagination or in actuality) such that he could represent various elements in relation to himself, one view at a time. Now he can imagine himself and other elements in a constant relationship as he portrays the scene.

In a study supporting Piaget's contention that conservation of distance precedes the coordinate concept.

[1]Malrieu (1950) claims that age 10 is when perspective appears.

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Earth-based Reference Frame. This was discussed earlier in terms of those pictures which were neatly drawn with fold-overs in the direction of compass points. These layouts usually involved the placement of buildings in the schoolyard. Now these directions might help the child organize his picture in his mind, but the representation of objects within this general external orientation would be from a single perspective.

Polar Coordinates. This is a 360° circle around the center as a starting point, with direction determined by lines radiating from the center and north representing 0°. Using a polar grid various landmarks can be used as the 0° starting point in place of due north. One thinks of this type of organization as a possible operational resolution of early thought which resulted in pictures showing multiple views from an imaginary center position on the page as in many (B) types.

Rectangular Coordinates. This is, of course, dependent on rectangular coordinate axes dividing the area into four quadrants. Now this type of coordinate system is the one on which the idea of a Euclidean grid must be based in order to represent a plane correctly. It appears to be more closely related to the (A) type of organization described earlier whereas the final possibility of developing reversible operations in terms of the other three reference frames seems to be more implicit in the (B) type organizations.

In any event, the visual realism of this stage depends on recognition of a three-dimensional Euclidean grid and, whether the child draws with a (B) type aerial view or with an (A) type horizon-oriented perspective, it must be incorporated into his representation of a plane.

Two other very important developments take place at this time which are directly related to the representation of three-dimensional objects on the simple plane which can now be created. The first of these is related to creation of geometric forms and orthogonals

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used to suggest foreground and background along a horizontal plane, for the child is now beginning to have success in his experiments with construction of angles and triangles. Although he most certainly will not be using measurements in creative drawing, he will gradually internalize the idea of being able to construct congruent forms such that he will spontaneously draw credible three-dimensional forms which depend on such congruencies.

Finally, Piaget says of the older operational child that he no longer creates simply kinetic images but that he now becomes capable of drawing "transformational" images which irvolve changing the shape of the object itself, such as the bending of a straight wire to form an arc (Piaget and Inhelder, 1969).

This is precisely the task which the child faces in making three-dimensional representations, for the characteristic conceptual or perceptual qualities that went into the construction of an internal image depended on elements seen from a classic frontal or profile view.

Now he is asked to twist, alter, partially obscure, and possibly foreshorten some of these elements. To show legs apart on a plane, the front leg must hide a portion of the rear one which is then also represented as smaller. The side of a building becomes a parallelogram instead of a simple rectangle, and part of the triangle of the distant portion of the roof is obscured so that only an obtuse angle remains, etc.

Stage VI (ages 10 to 11)

This is the culmination of drawing behaviors which constitute the possibilities in the course of normal development. It can best be described as a "Space Cell"[1] in which a focused moment of space/time[2] is encapsulated in a psychological "cube" of space

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[1]This term is used by Bachhofer in describing the culminating stage of development of ancient artists (1923).

[2]"We now see that the perception of time itself presumes, above all, an ordinal framework on the basic of which the perception of intervals or durations is organized. If this law is so general, might it not be applied equally well to space . . .?" (Piaget, 1969, p. 274).

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rather than being a representation in which physical objects are merely arranged on an undifferentiated plane.

In a sense, his representational conception borders on the idea of conservation of "occupied volume" which will become fully operational during adolescence. Formerly he could conceive of volume pertaining to individual objects alone, but in the Space Cell he begins to see the implication for that part of the volume of the surround which "is used up" or occupied by the objects.

We may recall that Piaget suggested that the very young child first believed that nature was controlled by man. He gradually came to regard nature as the cause of all, but still causing all for man. The significant change in viewpoint at this transitional stage is a dawning awareness not of nature for man, but of man in nature--and this is the psychic import of this culminating stage of drawing representation.

Flavell expresses it thus when describing the cognitive goal to be achieved vis-à-vis comprehension of the Euclidean world (1963, p. 335):

> What the child needs eventually to establish--and does not at first possess--is a picture of space as a kind of all-enveloping container made up of a network of sites or sub-spaces. Within the container are objects, the things contained, which move from site to site, now occupying or filling a given site, now leaving it unoccupied and empty.

Earlier we mentioned the vertical decalages which suggested hidden similarities between certain structures involved in the topological properties of order, enclosure, and continuity which were expressed variously in terms of Euclidean and perspective properties at later stages. In the Space Cell we can discern a very subtle expression of these properties which, though not structured in terms of formal operations, have nonetheless reached a certain satisfactory level of potential aesthetic fruition within the limits of concrete representations.

Typically this spatial style should be a possibility for the child who is entering junior high school and in many school systems will have a trained, specialized art teacher for the first time.

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Formal Operations (age 10-1/2 or 11 and on)

One might characterize the achievements of thought from now on as exhibiting a maximum coherency according to logical principles of which subjects are aware and which can be expressed[1]. There appears also to be the possibility of using hypothetical-deductive thought removed from direct dependence on concrete objects and situations.

The adolescent who has reached this stage, according to Piaget, is " . . . an individual who thinks beyond the present and forms theories about everything, delighting especially in considerations of that which is not" (Piaget in Laurendeau and Pinard, 1964).

The earliest age at which entry into Formal Operations is considered a likely probability is somewhere around 11, which means that very few of the seventh graders in this study could show firm evidence of having reached this level as a fully operational mode of thought. Indeed, there is much speculation regarding the number of young people who actually do reach this stage at all, the amount and kind of formal training which is involved, and at what ages it is accomplished.

For the purposes of this study, two aspects of thought are most relevant:

1) The removal from dependence on the "givens" of immediate, concrete reality might be thought of as the full ability to transform and manipulate reality in the form of symbols.
2) The idea of a maximum coherency according to logical principles suggests recognition of a structured whole within which possibilities can be explored and expressed.

We might wish to refer back to Bruner's (1970) description of the twofold aspects of the common method used by science and art alike in their search for the hidden harmonies of nature and being: ". . . construction of the tautly economical symbol" and

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[1] I am indebted to Dr. Wollman for suggesting use of this simplified description rather than an attempt to describe the complex "INRC" logical transformations usually involved in this stage definition.

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". . . construction and exploitation of the category of possibility, the formulated but empty category through which we search out new experience" [emphasis mine].

In a sense, we might consider this a capsule description of Piaget's stage of Formal Operations, mastery of which makes possible the most sophisticated, imaginative flights of man into the reaches of creative potential. Whether these symbols take a purely mathematical and scientific form or are possessed of rich spiritual and artistic imagery depends, of course, on the realm of possibility into which the mind has thrust its creative energy. That this capacity resides in our humanness itself--and not in any one particular activity or mode of expression over another--is a vision alternately obscure and obvious, hidden or revealed by the values prescribed by a society and the historical moment in which the activity manifests itself.

Drawings at this time can begin to show divergent cultural space styles[1], conscious abstraction, use of formal, taught rules of perspective, social commentary, the emergence of unique philosophical solutions, and aesthetic vitality.

Thus far we have mentioned only general characteristics of this stage. There are three special areas of spatial development which could not become fully operational until this time.

1) The projection of shadows can now be fully anticipated, thus making possible a more accurate and consistent portrayal of three-dimensionality in objects, and a greater sense of depth in

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[1] It is interesting to note that Far Eastern artists of ancient times chose an empirical, poetic organization of space in which local solutions contributed to the total illusion of depth. There was a kind of "piling-up" or "arranging" of separate space cells, so to speak.

Early Western artists sought a scientific, deductive approach to understanding of the problem and through careful observation and generalization (and eventually, the study of optics) gradually developed precise rules of perspective.

In 1946 Rader (Preface, p. xii) wrote ". . . the conquest of perspective by the great Western painters was no mere display of erudition or of virtuosity in imagination. It was what Oswald Spengler calls it, the creation of spiritual space, 'wide and eternal,' which responds to the imperious need of Western man for a symbol of distance and the infinite."

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the overall scene. This ability, after all, depends on the coordination of a number of earlier conservations such as perspective, proportion, and distance, and an adequate concept of construction of angles as well as the related idea of a plane along which a ground shadow can be cast forming a triangle with the light rays from the source and the interfering vertical.

2) It may be remembered that previously we mentioned that the topological property of continuity would not be conserved until the period of Formal Operations although, as with other vertical décalages, certain aspects might be expressed at earlier stages of development. With this new concept of infinity--indefinitely continuous subdivision of the whole--comes the possibility of truly understanding and using the idea of a vanishing point. It appears that this construct never arises spontaneously in the child's drawing development, but must be taught when the child is ready to understand the formal laws of perspective rendering.

3) Earlier only one aspect of volume had been conserved, the idea of interior volume. But now a more complex form of conservation is possible with the notion of occupied or displaced volume. Genevan experiments usually involved water displacement type tasks. However, the relationship of this concept to drawing is a subtle one involving not only the physical but the psychic and expressive space taken up by objects within the confines of the picture boundaries.

Summary

Development, then, is movement away from the static and egocentric: it is movement towards reversibility and active, expressive relationships. One might think of stages as representing points of equilibrium in which the relationship between the movability of the figures and the ground on which they move about attains congruity. In the early period of greatest contrast of direction of line in individual forms (static period), figures are merely "listed" among other immovable objects on the page. As variability of direction of lines is attempted, combined forms appear which begin to suggest action. It is at this time that

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groping begins for a way to relate these figures to a representational ground area. At first, stationary objects such as trees, houses, etc., may join the schematic representation of ground, but it is not until later that kinetic figures can actually move about on this ground rather than float above it or merely along the paper edge alone.

When figures achieve the ability to twist and turn in a three-quarter view, a plane must exist to accommodate the new physical relationships which are then possible.

Ultimately, physical positioning on a simple, undifferentiated plane from foreground to background appears too limiting as these highly expressive figures begin to possess the potential for moving about in psychic space. At this point a space cell (a cube of space) is forced into being, completing a final and satisfying equilibrium in the noraml development of both children and the ancients and, at the same time, opening up an endless vista for exploration into the realms of fantasy, abstraction, perspective accuracy, and poetic expression.

This idea of movement pervades Piaget's theories. His description of the development of the image is couched in action terms: "static, kinetic, transformational." Furthermore, not only does the dynamic concept of reversibility and equilibrium which underlies the whole system depend upon movement, but the conditions which he considers essential for the transition from the beginning Sensori-motor level to the reflective level of Formal Operations depend on the idea of action. The first of these is increased speed in coordinating knowledge of successive phases of action into a simultaneous entity. The second involves the search for awareness of the mechanisms of action. And finally, ". . . an increase in distances, enabling actions affecting real entities to be extended by symbolic actions affecting symbolic representations and thus going beyond the limits of near space and time" (Piaget and Inhelder, 1969, p. 121).

In conclusion, let us notice once more how closely the vision of the scientist and the artist resemble one another. Paul Klee

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has written[1]:

> Action may well be the start of everything, but actions are governed by ideas. And since infinity has no beginning, like a circle, ideas are the primary realm . . .
>
> Movement is the source of all growth. In Lessing's Laokoon, the subject of so much mental exercise in our younger years, there is much ado about the difference between time and space in art. Once we examine it more closely, this is really just a bit of erudite hair-splitting for space, too, implies the concept of time.
>
> It takes time for a dot to start moving to become a line, or for a line to shift its position so that a plane is formed. The same is true of the plane that moves and thus defines a space. . . .
>
> Character, too, is movement. Only the single dot, which has no life, no energy, lacks the dimension of time . . .
>
> Throughout the universe, movement is the rule. On this earth, rest is no more than a fortuitous clogging of the flow of matter. To accept this chance event as the primary condition is an error.

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[1]Quoted in Will Grohmann, Paul Klee, Harry N. Abrams, Inc., New York (1954), p. 98, from Klee's Schöpferische Konfession (1920).

[2]Another highly verbal artist who speaks to this point is Gyorgy Kepes, "The Representation of Movement," The Language of Vision, Paul Theobald & Co., Chicago (1944).

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III STATISTICAL ANALYSIS AND FINDINGS

DISCUSSION OF ANALYSIS

Overall Description

The data for each country was coded according to the following variables:

Sex: Male, Female

Class: Lower, Middle

Age: 4 to 20 (in steps of 1 year)

Art Score: 1, 2, 3, 41, 43, 5, 6, 7

Note: 41 (includes 42) is the code for lower level
43 (includes 44) is the code for upper level

Drawing Style: A, B or C

Reading Ability: Good, Medium or Poor

(This was done only for the following populations: Oakland, Brazil, India, Hong Kong, Cincinnati)

(I) Age vs. Art Score

Tables[1] 1(a), 1(b), 1(c), 1(d) and 1(e) show the distribution of age vs. art score for the total population, lower class, middle class, males and females respectively.

From each of these tables the average age vs. art score was obtained. The standard deviations at each art score level were also computed. The range of ages at each level could also be obtained. These statistics are graphed on graphs 1, 2 and 3.

The tables and graphs show that for each population the sequence occurs in roughly the same order. The average age is approximately an increasing function of the art score. The one or two exceptions that occur at the tail end (around art scores 5, 6 or 7) may be due to the small number of observations at the tail end. The majority of the observations lie in the range Art Score 2 - 5 and in this range the average age is an increasing function of art score.

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[1] A complete listing of computer print-out tables is given in Appendix 5. Any of these will be made available on request.

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(II) Class Differences

To answer the question of whether differences (as measured by the art score) between the middle class and lower class are significant, the following procedure was used. The population was divided into two categories, male and female, and examined grade by grade. For each grade and sex (and also for both sexes combined) the art scores of the lower and middle class were examined. These are given in the set of tables numbered (2). The hypothesis H_0 of no difference in the distribution of art scores of lower and middle class children was tested against the alternative H_1 that the distribution for middle class children is shifted to the right of the corresponding distribution for lower class children. Roughly speaking the alternatives specify that middle class children tend to have higher art scores. The usual normal theory tests such as the t-test for the difference of means were not applied because of the "lumpiness" of the data. The scores themselves are discrete and there are several observations at each score. A non-parametric approach was adopted and the Mann-Whitney form of the Wilcoxon test with allowance for ties was used.

The test is carried out as follows.

Example:

Art Score	1	2	3	41	43	5	6	7	Total
Group A (lower)	a_1	a_2	a_3	.	.	.	.	a_7	m
Group B (middle)	b_1	b_2	b_3	.	.	.	.	b_7	n
	d_1	d_2	d_3	.	.	.	.	d_7	N

Males, Grade 1

The entry a_1 means that a_1 children of group A have art score 1, etc. d_1 represents the total number in both groups having art score 1. m and n are the group totals and $N = m + n$.

The quantity W_{AB} is computed where W_{AB} is the Mann-Whitney statistic (computed allowing for ties) between groups A and B. Every time an art score in group A is strictly less than an art score in group B this pair of scores adds 1 to W_{AB}. If an art score in group A is equal to an art score in group B this pair of

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scores adds 1/2 to W_{AB}. If the A score is greater than a B score this pair adds 0 to W_{AB}.

Thus, $W_{AB} = a_1 b_1 \cdot 1/2 + a_1(b_2 + b_3 + \ldots)$

$+ a_2 b_2 \cdot 1/2 + a_2(b_3 + b_{41} + \ldots)$ etc.

The hypothesis H_0 of no difference between groups A and B is rejected if W_{AB} is sufficiently large.

The expectation μ and variance σ^2 of W_{AB} under H_0 are given by $\mu = (1/2)mn$ and

$$\sigma^2 = (1/12)mn\,(N + 1)\left[1 - \frac{\Sigma(d_i^3 - d_i)}{N^3 - N}\right] \text{ respectively.}$$

$T = \dfrac{W_{AB} - \mu}{\sigma}$ is approximately standard normal if m and n are large.

T is computed for each table and called the Wilcoxon statistic in the computer print-out. At the 5% level of significance H_0 is rejected if $T \geq 1.645$.

The computer print-out also shows Delta (Δ), the Hodges-Lehmann estimator for the shift in the distribution of the art scores of the middle class group.

Also printed out are the average art scores for the two groups. The difference between these two averages will yield the classical estimator of the shift if a normal model is assumed.

The reader who wishes a more complete discussion of these and related procedures is referred to Lehmann, "Statistical Methods Based on Ranks." Tables for carrying out normal and related tests can be found in Lehmann or Owen, "Handbook of Statistical Tables."

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

A further examination of the basic question raised in (II) is carried out in the set of tables numbered (3). The population is divided into male and female (later these are combined) and A and B styles. For each particular art score, style and sex the distributions of ages for the lower and middle class were examined. A Wilcoxon test was applied to the distributions to test whether the distribution of middle class ages was shifted to the left. Roughly speaking the question of interest can be phrased as follows: "Are

the two distributions the same or do middle class children arrive at this particular stage (art score and style) earlier than lower class children?" In this case small values of T are significant. Estimates are given of the shift in age distribution.

(IV) A/B Style Comparisons

These statistics are given in the tables numbered (4). The population is divided by sex and class and for each grouping of sex and class (later sexes are combined and classes are combined) the age distribution of A style children at a particular art score is compared with the age distribution of the corresponding B style children. This is done for scores 41, 43 and 5 since these were where differences (if they existed) would be of greatest interest.

The Wilcoxon test is applied to these sets of data. Graph (4) shows the numbers of males and females in each of the stages:

41A 41B
43A 43B
and 5A 5B

Graph (5) shows the numbers of lower and middle class children in each of the above stages. Graph (6) shows the comparison between the average age for each art score for A types and B types. This is done by looking at the average age for the entire population. A more detailed picture of the overall age distribution for the 41A vs. 41B types and the 43A vs. 43B types is given as graphs (7) and (8) respectively.

To answer the question of whether the tendency to draw A type or B type drawings is connected with sex (or class) the following test was carried out for each population. For each of the stages 41, 43 and 5 the population was classified according to sex (later according to class) and A or B type. A typical table would look as follows:

	Male	Female	Total
41A	a	b	a + b
41B	c	d	c + d
Totals	a + c	b + d	N = a + b + c + d

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The quantity $X = \frac{(ad - bc)^2 N}{(a + b)(c + d)(a + c)(b + d)}$ was computed and the hypothesis of independence between sex and drawing style was rejected if $X \geq 3.84$, since under the hypothesis of independence X is approximately a chi squared variable with 1 degree of freedom.

The results may be summarized as follows:

(a) Drawing style vs. sex:

The hypothesis of independence was only rejected for the following cases:

India: 41A/B vs. sex: Males more B's than A's, Females more A's than B's

Italy: 41A/B vs. sex: Males more B's than A's, Females more A's than B's

Brazil: 41A/B vs. sex: Males more B's than A's, Females more B's than A's but proportion of B's to A's is significantly higher for males

Denmark: 43A/B vs. sex: Both sexes have more A's than B's but the proportion of A's to B's for males is significantly higher than the proporcion for females

(b) Drawing style vs. social class:

The hypothesis of independence between drawing style and class was only rejected for the following cases:

Brazil: 41A/B vs. class: middle class has a significantly higher proportion of B's to A's than the lower class

India: 41A/B vs. class: middle class more A's than B's, lower class, more B's than A's

Italy: 5A/B vs. class: middle class has a significantly higher proportion of A's to B's than the lower class

Hong Kong: 43A/B vs. class: lower class has more B's than A's, middle class has more A's than B's

(V) Reading Score Comparisons

Whenever reading scores were available the following question was of interest. Do the best readers tend to have the highest art

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scores and the medium readers the next highest art scores and the poorest readers the lowest art scores?

A test of the hypothesis that the art score distributions for these three groups of readers is the same against ordered alternatives that the distributions are shifted ("medium reader" distribution shifted to the right of "poor reader" distribution and "good reader" distribution shifted to the right of "medium reader" distribution) has been proposed by Jonckheere.

Jonckheere's test for ordered alternatives (the test is modified to take into account tied observations) was applied to the data. In addition to this a "maximin" test was applied to the data. Jonckheere's test is appropriate if a linear shift model is assumed with the ordered alternatives specifying equally spaced shifts. If one has no idea of the relative spacing of the shifts then the maximin test provides a "conservative" test for such ordered alternatives. For details of the maximin test the reader is referred to D'Abrera (1973) and for details of Jonckheere's test to Lehmann or D'Abrera (1973).

Reading score comparisons of two types were made. Tables 5(a) show comparisons among readers by examining art scores for each sex and grade. Tables 5(b) show comparisons among readers by examining the age distribution for each sex and art score. These tables also include the case where male and female populations are combined. The related graphs are given as (9), (9a) and (10).

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GENERAL RESULTS IN TERMS OF INITIAL HYPOTHESES

1. Similar developmental characteristics were observed in all societies except in the Amazon population. Here there was generally no attempt at visual realism except in the case of a few isolated objects in 3 drawings at the Cururu mission school.

   All three styles--A, B, and C--appeared in every population, including the Amazon Indians.

2. In every population average age is an increasing function of art score.

3. Where social class differences appeared, significance was usually found in the direction of higher middle class scores, with one small exception in Brazil.

4. Of the populations examined there was only one non-literate society (Amazon) and one low literacy society (India). Only 2 in the Amazon reached Stage 41, none going beyond. These, and the largest number of Stage 3 drawings (10 times either of the other 2 groups) appeared in the most developed group. Drawings in India were taken from one of its most modernized cities, Bombay, hence not representative of the areas where literacy is especially low. Nonetheless there were a larger number of children drawing at the lower levels and ages were generally shifted to the right.

   The Taylor and Hudson tables (pp. 42-46) can be used by the reader to make further comparisons with art score mean age, and range data given in the following pages.

5. Reading scores were available for only 6 populations. In 3 of these there was a significant correlation for at least 3 grades. In one there was significance for 2 grades. In one there was significance only at one grade. And in one country there was no significance (however, the absence of data for first and third grade medium level readers there prevented use of the statistical tests especially designed to examine these data).

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6. Greater social class differences between middle and lower groups were generally observed in more sharply stratified societies. Difference was observed between the very high and very low groups in Denmark, a relatively homogeneous society, where the middle class was not tested.

OVERVIEW OF STATISTICAL FINDINGS RELATED TO SPECIFIC QUESTIONS

(I) Age vs. Art Score

Is average age an increasing function of art score?[1]

Brazil, São Paulo

Yes, *with the exception of a tiny dip at Stage 7 (2 observations).

Brazil, Amazon area

Unknown. Only 2 subjects received an art score as high as Stage 41. All but 6 of the Stage 3 drawings came from the Cururu mission school. Hence there was no opportunity to examine age trends with art score hierarchy. Of this group, less clear forms were generally produced by the younger children and members of the least developed social group.

Denmark, Copenhagen

Yes, with a dip at Stage 6 (27 observations).

Germany, Saarbrucken

Yes, with a slight dip at Stage 7 (6 observations).

Greenland

Yes, with a slight dip at Stage 6 (12 observations).

Hong Kong, Kowloon

Yes, *with a dip at Stage 6 (20 observations) and a tiny dip at Stage 7 (4 observations).

India, Bombay

Yes, with a dip at Stage 5 (39 observations) and *a slight dip at Stage 6 (8 observations).

Italy, Milan

Yes, *with a dip for males at Stage 5 (34 observations) and *a large dip for females at Stage 41 (239 observations).

[1]These are general population trends: special observations by group are marked with an asterisk.

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Japan, Tokyo

Yes, with a dip at Stage 6 (25 observations) and *a dip at Stage 7 (13 observations).

U. S. A., Cincinnati, Ohio

Yes, *with a tiny dip at Stage 6 (2 observations) and *a slight dip at Stage 7 (6 observations).

U. S. A., Guadalupe and Tempe, Arizona

Yes, *with a tiny dip at Stage 5 (3 observations).

U. S. A., Oakland, California

Yes, with a slight dip at Stage 6 (5 observations).

U. S. A., Palo Alto, California

Age not examined, only style.

(II) Class Differences

Is there a significant difference between the middle and lower class as measured by the art score attained?

Brazil, São Paulo

Grades 0, 1 and 2 middle class significantly higher.
Grades 3 and 5 lower class significantly higher.
Other grades no significant differences.
(Most striking significant difference appeared at grade 1 where middle class was higher.)

Brazil, Amazon area

There were no class differences to be examined. However, a significant correlation for both sexes was found in the direction of higher art score and greater degree of contact with civilization.

Denmark, Copenhagen

All grades upper class significantly higher. However, it is important to note that the contrast here is between the high and low classes, rather than middle and low.

Germany, Saarbrücken

All grades--no significant difference.

Greenland

All grades--no significant difference.

Hong Kong, Kowloon

Grades 1, 3 and 5, both sexes, middle class significantly

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higher by great degree.

India, Bombay

All grades middle class significantly higher by great degree. Striking difference at grades 1, 3 and 5.

Italy, Milan

Grades 5 and 7 middle class significantly higher.

Japan, Tokyo

All grades--no significant difference.

U. S. A., Cincinnati, Ohio

All grades middle class significantly higher by great degree (middle class is white, lower class almost all black).

U. S. A., Guadalupe and Tempe, Arizona

All subjects lower class.

U. S. A., Oakland, California

Grades 1, 3 and 5 middle class significantly higher when Blacks and non-Blacks are combined. Difference is most striking at grade 1.

When examined ethnically by class, lower class non-Blacks are significantly higher at grade 1 and middle class non-Blacks are significantly higher at grades 1 and 7; no significant difference found at grades 3 and 5.

U. S. A., Palo Alto, California

All subjects middle class.

(IV) A/B Style Comparisons

Is there a difference in use of A or B drawing style by social class?[1] (The following are general trends. The few statistically significant cases have already been cited in the "Discussion of Analysis" section, pp. 113-114.)

(a) Stage 41

Both social classes showed greater use of B style than A with the exception of middle class India females.

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[1]That this is a relatively stable choice at any given age is attested to by the study in Palo Alto where only 5 out of 169 showed any shift from one style to another. In these cases the shift was always from B to A where it stabilized or shifted back to B again. These were all level 4 drawings.

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Social class proportions of B over A:

Brazil, São Paulo: middle class higher

Denmark, Copenhagen: upper class higher

Germany, Saarbrücken: 3 times as many middle class, 2 times as many lower class

Greenland: middle class higher

Hong Kong, Kowloon: 8 times as many middle class, 10 times as many lower class

India, Bombay: lower class higher

Italy, Milan: no class difference

Japan, Tokyo: lower class barely higher

U. S. A., Cincinnati, Ohio: no class difference

U. S. A., Guadalupe and Tempe, Arizona: only lower class sample

U. S. A., Oakland, California: 2 times as many B's as A's for both classes

U. S. A., Palo Alto, California: only middle class sample

(b) Stage 43

Both social classes showed a general shift toward a preponderance of A's over B's except in Hong Kong which still showed a larger percentage of B's over A's (2 to 1) in lower class whereas the middle class showed preference (2 to 1) for A's over B's.

Social class proportions of A over B:

Brazil, São Paulo: lower class higher

Denmark, Copenhagen: lower class higher

Germany, Saarbrucken: middle class higher

Greenland: ratios even

India, Bombay: middle class higher

Italy, Milan: middle class higher

Japan, Tokyo: ratios even

U. S. A., Cincinnati, Ohio: lower class higher

U. S. A., Guadalupe and Tempe, Arizona: only lower class sample

U. S. A., Oakland, California: lower class higher

00132

(c) Stage 5

Both social classes showed a preference for A's over B's generally with these exceptions:

Greenland: both classes preferred B over A

Japan, Tokyo: both classes preferred B over A but lower class by a proportion twice as large as middle class.

Is there a difference in use of A or B drawing style by sex?

(a) Stage 41

More B's than A's in all groups except females in India and Italy who produced significantly more A's.

(b) Stage 43

More A's than B's in all groups except males in Hong Kong and females in Japan.

(c) Stage 5

More A's than B's in all groups except males in Germany, males and females in Greenland, and males and females in Japan.

(V) Reading Score Comparisons

Do the best readers tend to have the highest art scores and the medium readers the next highest art scores and the poorest readers the lowest art scores?[1] Information was available for six populations only.

Brazil, São Paulo

Yes, but significance appeared in grade 5 males only

Hong Kong, Kowloon

No significance appeared. However, special statistical tests could not be used at grades 1 and 3 because no medium level readers were recorded.

India, Bombay

Yes, but significance appeared only in grades 5 and 7 (especially in grade 7 males)

Italy, Milan

Yes, with significance in grades 3, 5 and 7

[1] These findings may have been affected by statistical design such that they could have suggested less significance than there actually was. This will be discussed in the concluding remarks.

00133

U. S. A., Cincinnati, Ohio

Yes, striking significance at all grade levels

U. S. A., Oakland, California

Yes, all except grade 7 (especially significant were grade one Blacks)

00134

FINDINGS BY POPULATION

Legend for Graphs

For each country the following graphs are provided:

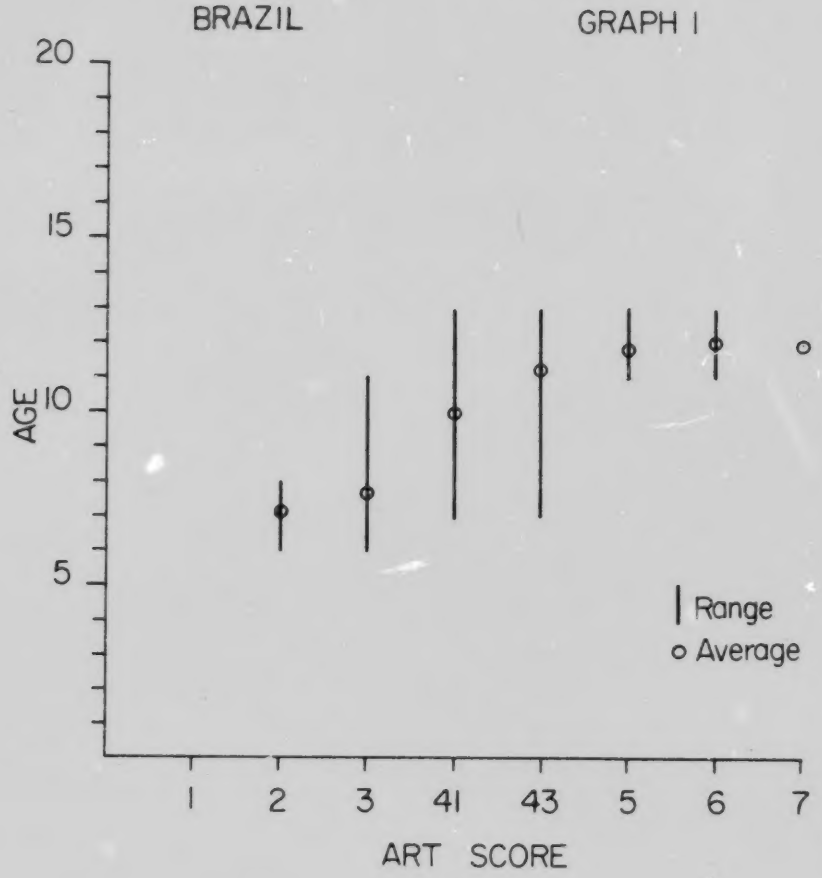
Graph No.

1	Average age vs. art score computed for the whole population
2	Average age vs. art score for male and female populations
3	Average age vs. art score for lower and middle class populations
4	Frequencies of males and females in each of the stages 41A, 41B, 43A, 43B, 5A and 5B
5	Frequencies of lower and middle class observations in each of the stages 41A, 41B, 43A, 43B, 5A and 5B
6	Average age vs. art score for A types and B types (total population)
7	Age distribution (total population) of 41A and 41B types
8	Age distribution (total population) of 43A and 43B types

Where reading scores are available:

9	Frequency plots for poor, medium and good readers (both sexes combined) vs. art scores for each grade sampled
9a	Relative frequency distributions for poor, medium and good readers (both sexes combined) vs. art scores for each grade sampled
10	Age distributions of poor, medium and good readers for fixed art scores and sex for specified cases (details given on graphs)

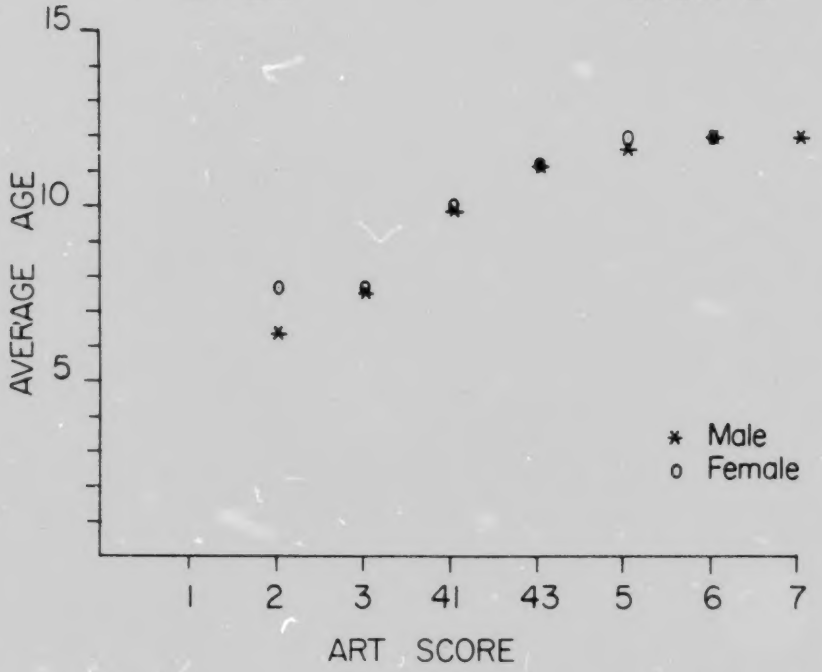
00135


BRAZIL
GRAPH I
20
15
10
5
AGE
Range
Average
1
2
3
41
43
5
6
7
ART SCORE

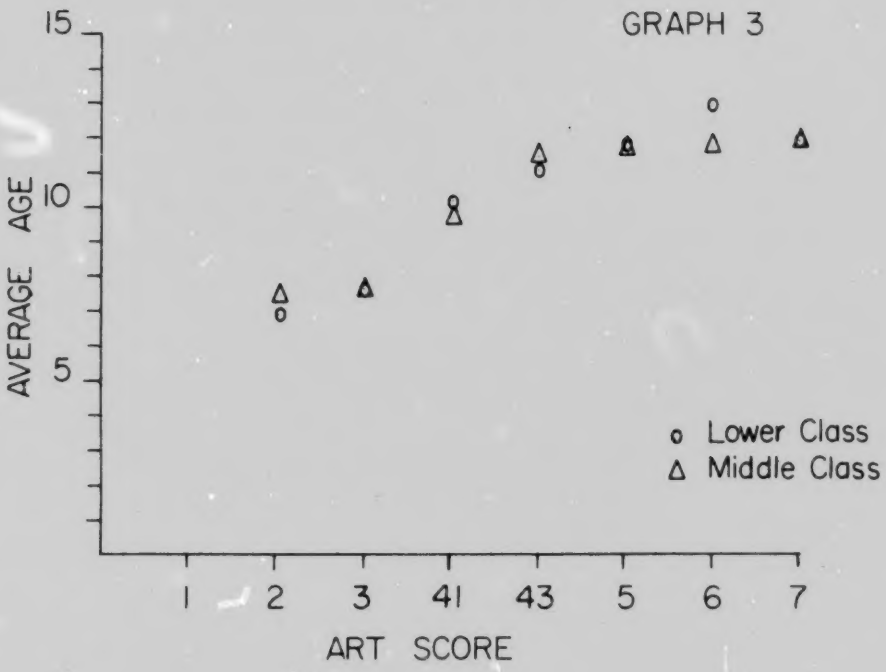
00136

BRAZIL

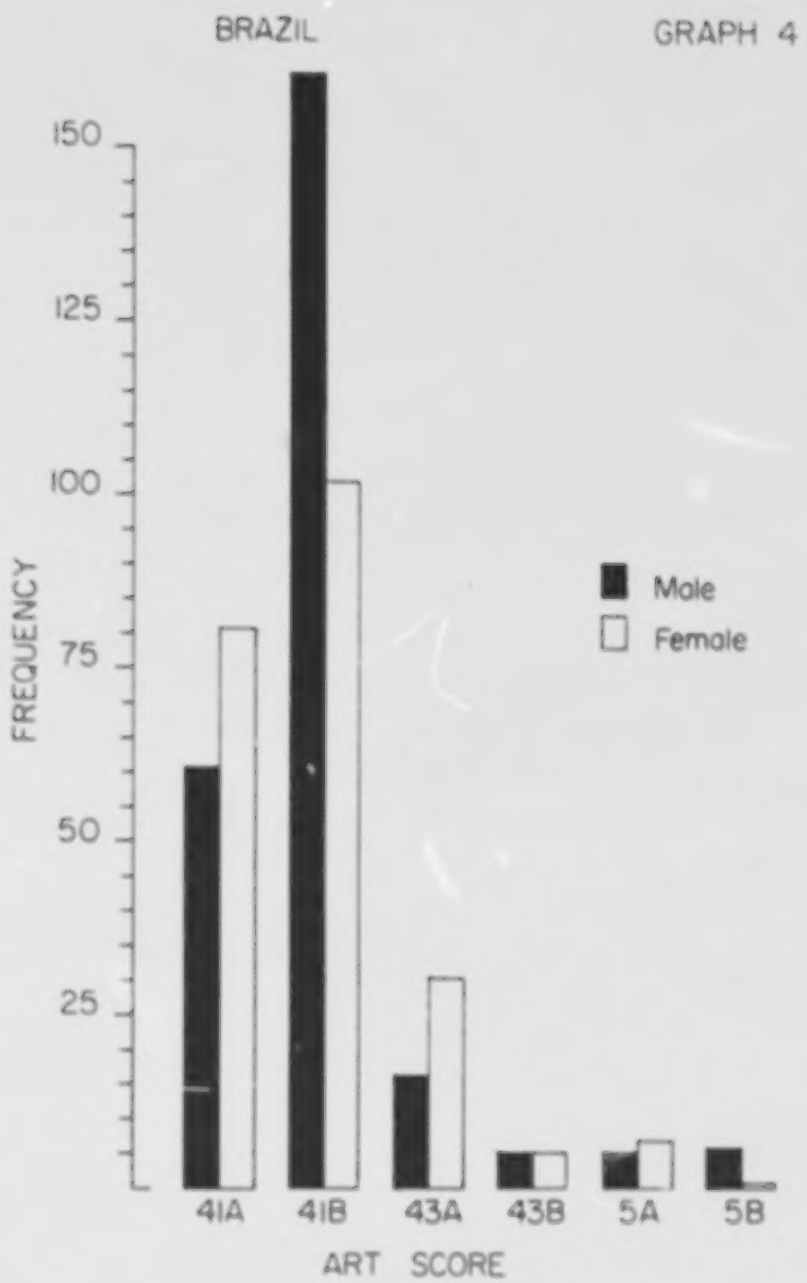
GRAPH 2



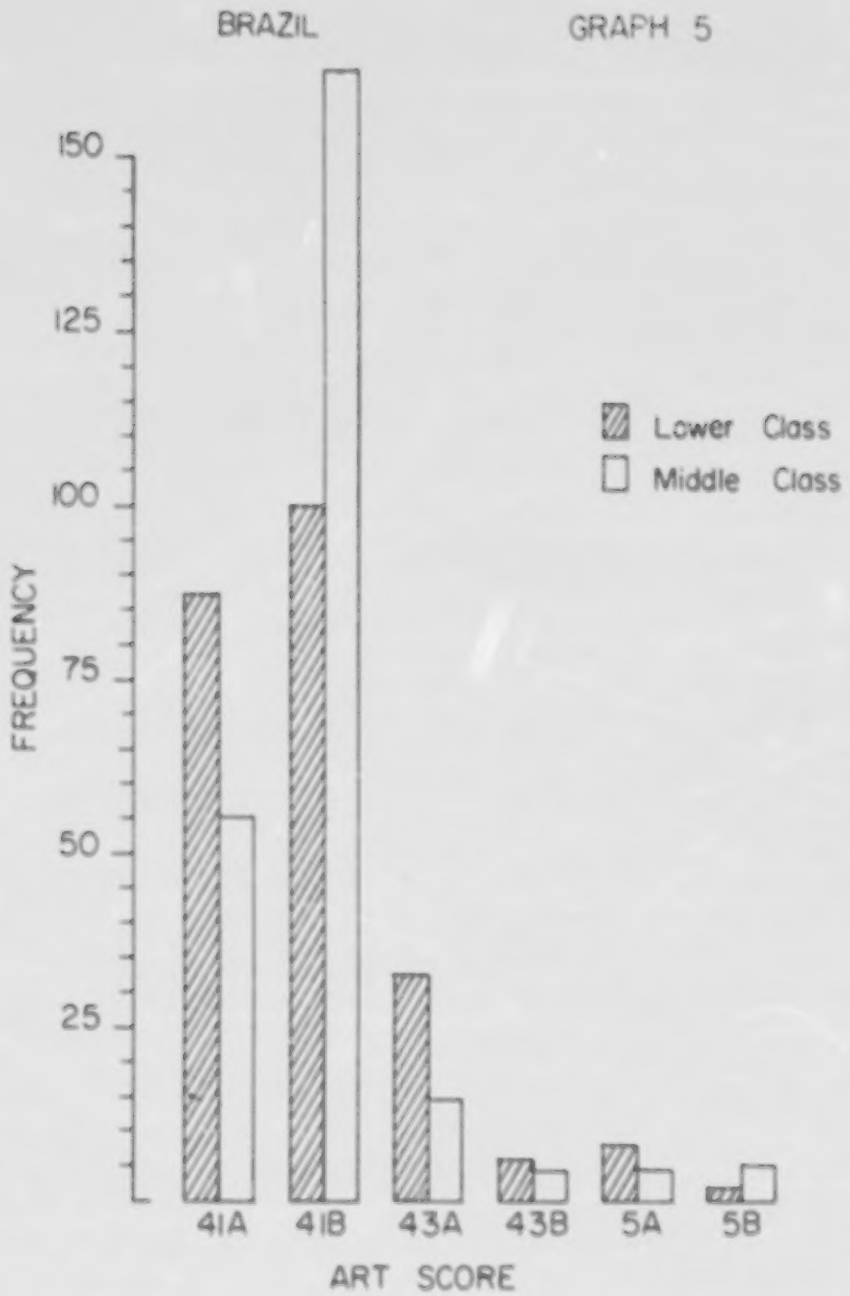
GRAPH 3



99137


BRAZIL
GRAPH 4
150
125
100
75
50
25
FREQUENCY
Male
Female
41A
41B
43A
43B
5A
5B
ART SCORE

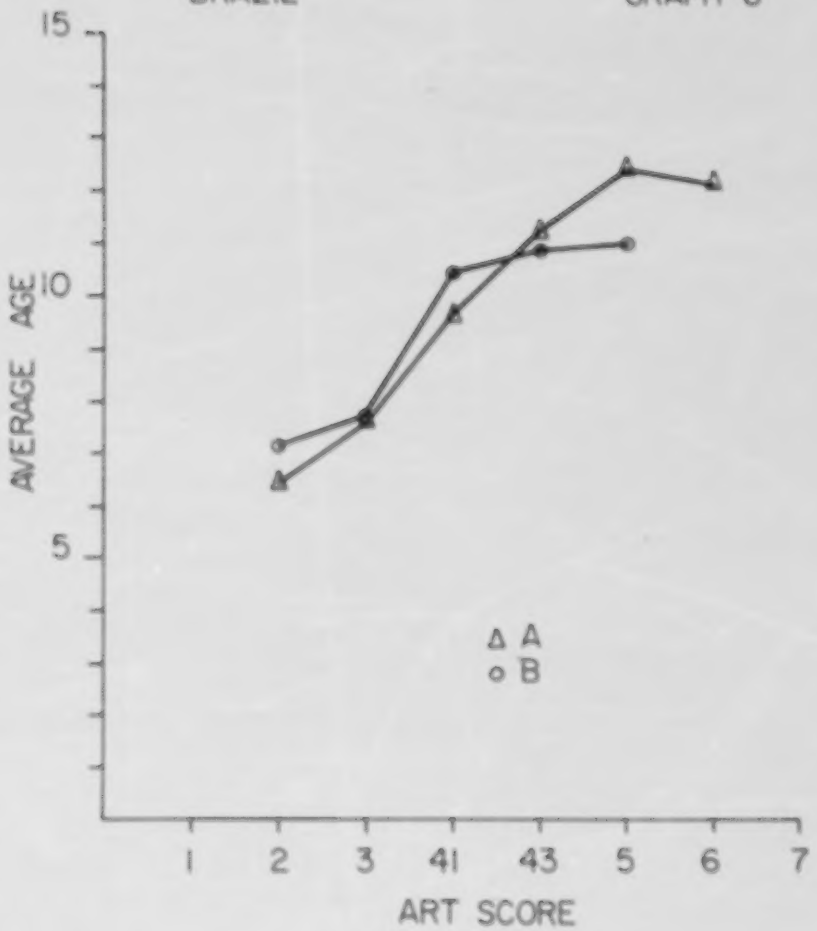
00135


BRAZIL
GRAPH 5
150
125
100
75
50
25
FREQUENCY
Lower Class
Middle Class
41A
41B
43A
43B
5A
5B
ART SCORE

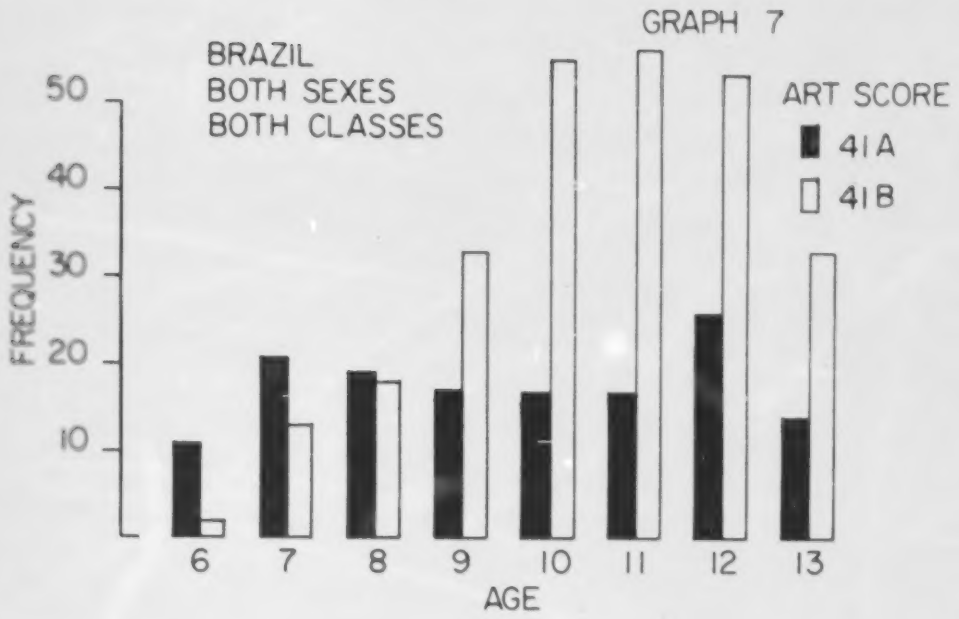
00139

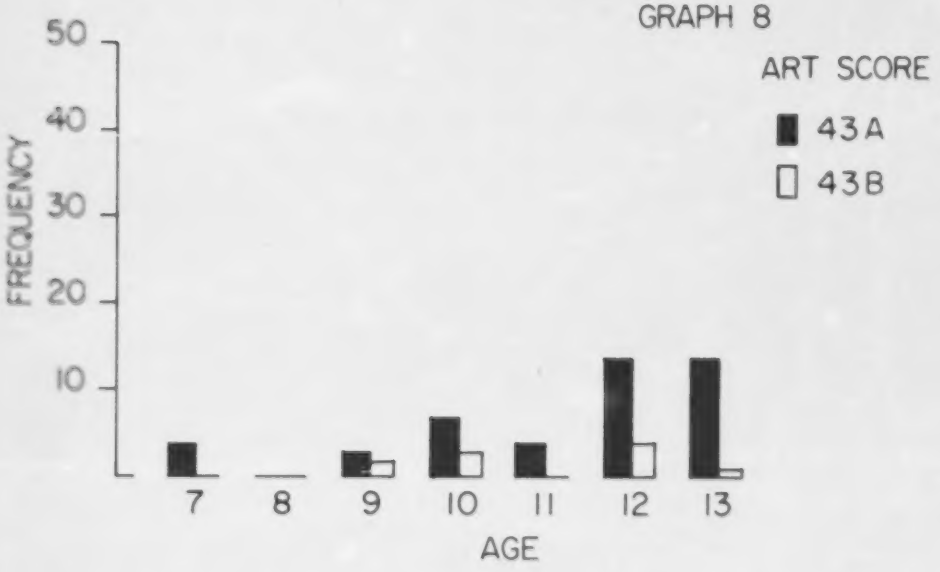
BRAZIL

GRAPH 6



00140

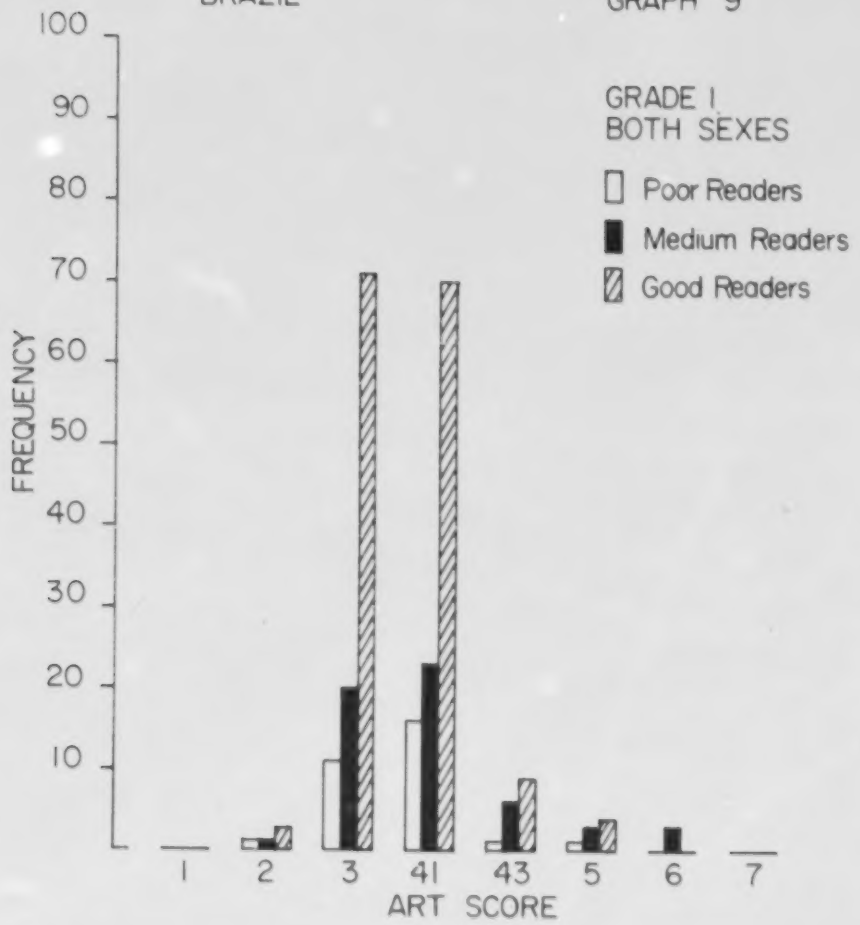

GRAPH 7
BRAZIL
BOTH SEXES
BOTH CLASSES
ART SCORE
41A
41B
FREQUENCY
50
40
30
20
10
6
7
8
9
10
11
12
13
AGE

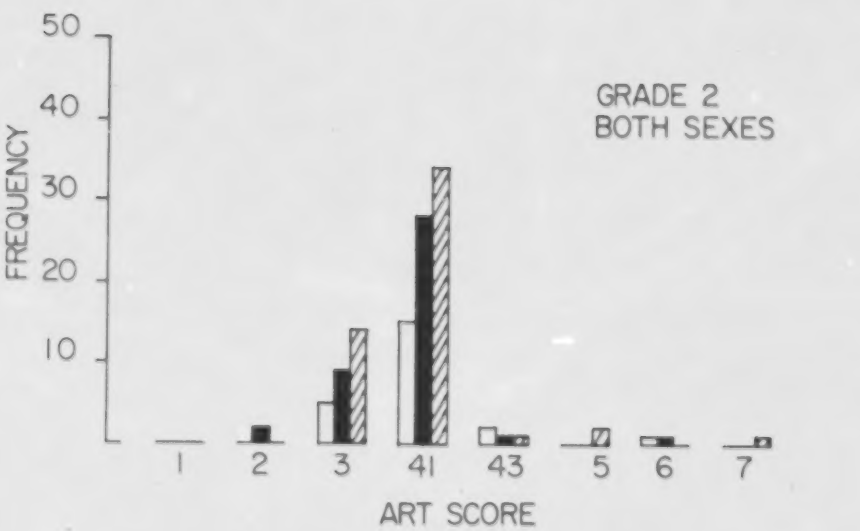

GRAPH 8
ART SCORE
43A
43B
FREQUENCY
50
40
30
20
10
7
8
9
10
11
12
13
AGE

00141

BRAZIL

GRAPH 9

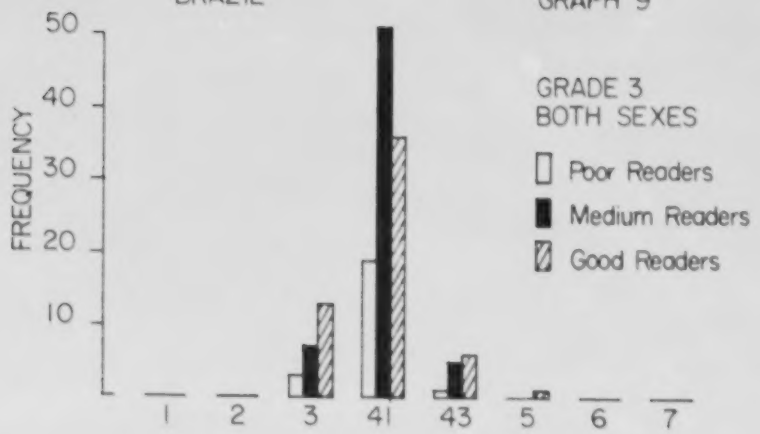


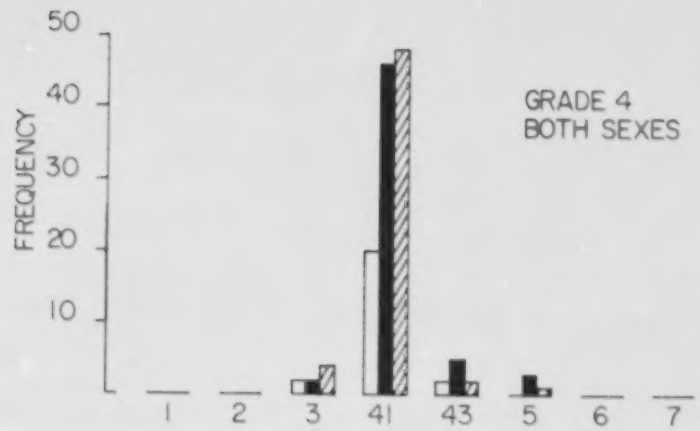


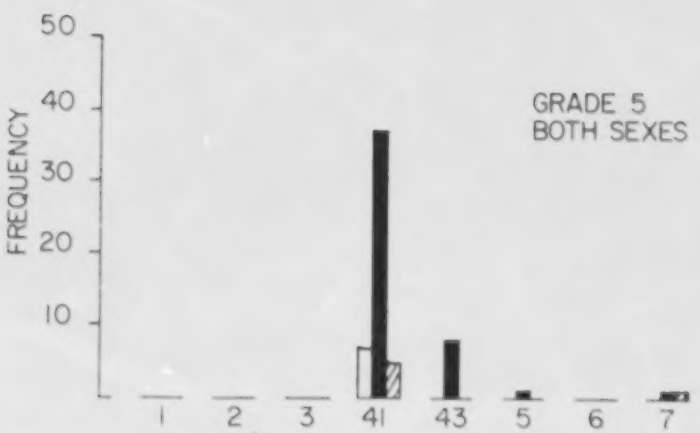
00142

BRAZIL

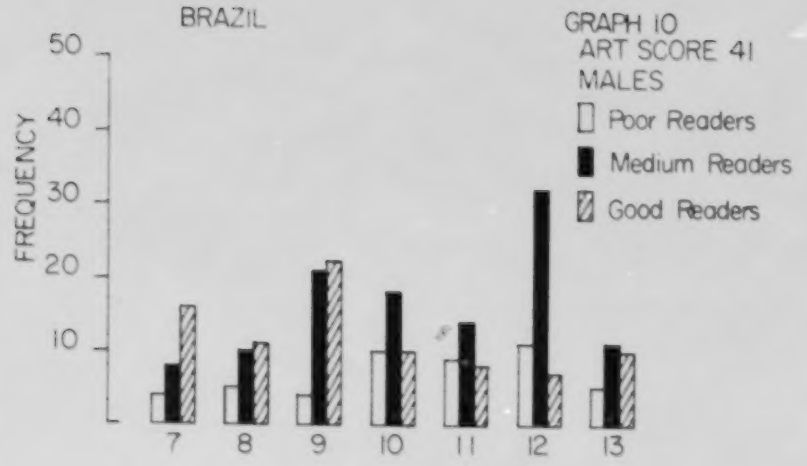
GRAPH 9

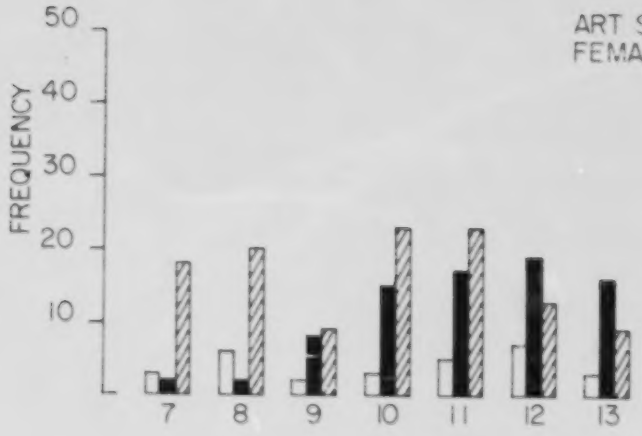


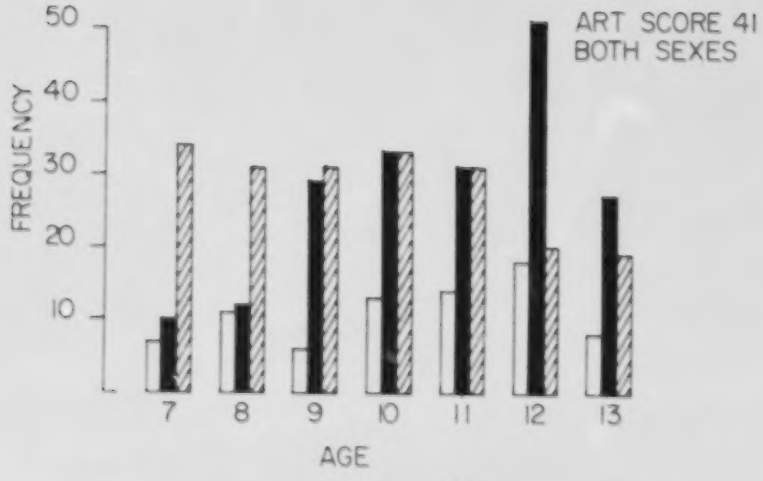




00143


BRAZIL
GRAPH 10
ART SCORE 41
MALES
Poor Readers
Medium Readers
Good Readers
FREQUENCY
50
40
30
20
10
7
8
9
10
11
12
13


ART SCORE 41
FEMALES
FREQUENCY
50
40
30
20
10
7
8
9
10
11
12
13


ART SCORE 41
BOTH SEXES
FREQUENCY
50
40
30
20
10
7
8
9
10
11
12
13
AGE

00141

Brazil, São Paulo

	Lower	Middle	
Male	174	238	412
Female	224	161	385
	398	399	797

(I) Age vs. Art Score

1(a) Total population: average age is an increasing function of art score

1(b) Lower class: same as 1(a) (Dip at score 7 based on 2 observations)

1(c) Middle class: same as 1(a)

1(d) Males: same as 1(a)

1(e) Females: same as 1(a)

(II) Class Differences

For grades 0, 1, 2, 3, 4, 5 and 6 art score and class were examined.

Total population: For the early grades 0, 1 and 2 the middle class children have significantly higher scores. For grades 3 and 5 the reverse appears to hold. This pattern is repeated for both sexes when the population is broken down by sex. The most striking difference was observed in grade 1.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

For the combined population in 3A and 41A the middle class age distribution was found to be shifted significantly to the left of the lower class distribution (estimated shift 1 year in both cases). When split on sex this was found to be also true of females but not of males.

(IV) A/B Style Comparisons

(a) 41A/B

Overall population: significant shift of 41B age distribution to the right (i.e., B types tend to be older, estimated shift 1 year).

00143

When split on sex the same is true for 41B males (estimated shift 2 years older). When split on class this is also true for the middle class where the estimated shift is 2 years (older) for 41B types. When split on sex and class only lower class females did not yield a significant result.

(b) 43A/B

No significant shifts.

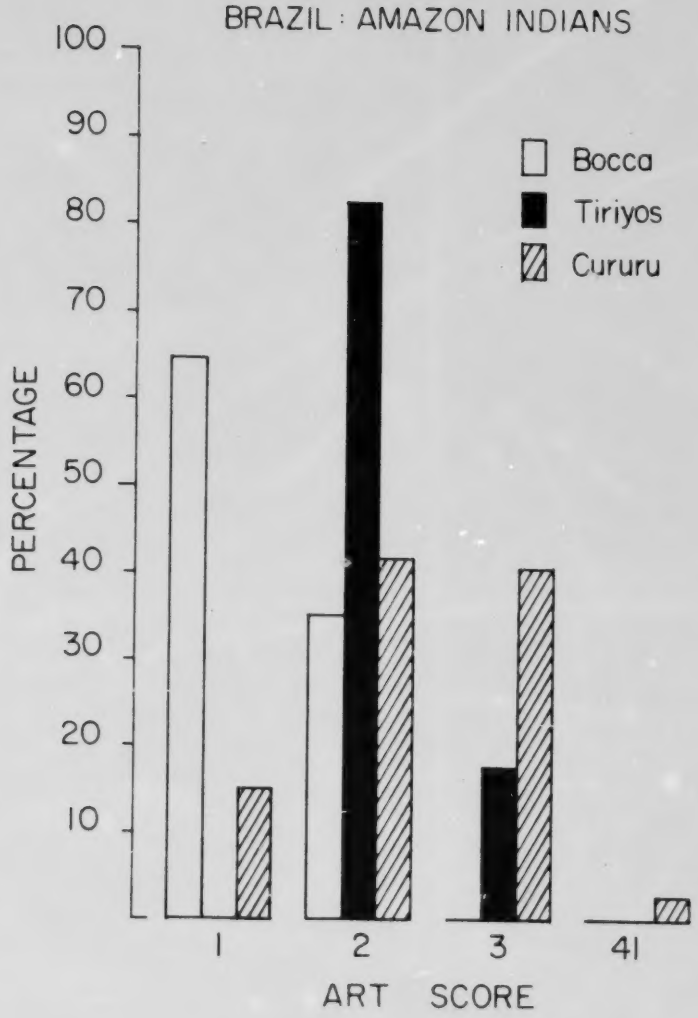
(c) 5A/5B

Based on relatively small samples 12 (5A's) and 7 (5B's) the A's were significantly older than the B's when the total population of 17 children was considered.

(V) Reading Score Comparisons

Overall population examined grade by grade: Do better readers have higher art scores? There was only one significant result from these tables. Only males in grade 5 showed significance. However, when the population for each art score was examined those with art score 41 gave significant results. This was true also for 41 males and for 41 females. For the overall population of children with art score 41 estimates of the shifts were about 1 year in average age between groups.

00146


BRAZIL: AMAZON INDIANS
100
90
80
70
60
50
40
30
20
10
PERCENTAGE
Bocca
Tiriyos
Cururu
1
2
3
41
ART SCORE

00147

Brazil, Amazon area

This was a special population that could not be coded adequately according to class or age.

However, we can construct the following table from the data:

Art Score	1	2	3	41	Totals
Bocca	11	6	0	0	17
Tiriyos	0	14	3	0	17
Cururu	11	30	29	2	72

Using Jonckheere's test to test the hypothesis H_0 of no difference in the distribution of art scores of three populations against the ordered alternative H_1 that those in Cururu tend to have the highest scores, those in Tiriyos the next highest and those in Bocca the lowest scores we find that H_0 is rejected. The significance probability of the test is less than .001.

For completeness the following breakdown by sex is also provided. (There were a few subjects in the total population who were not classified according to sex.)

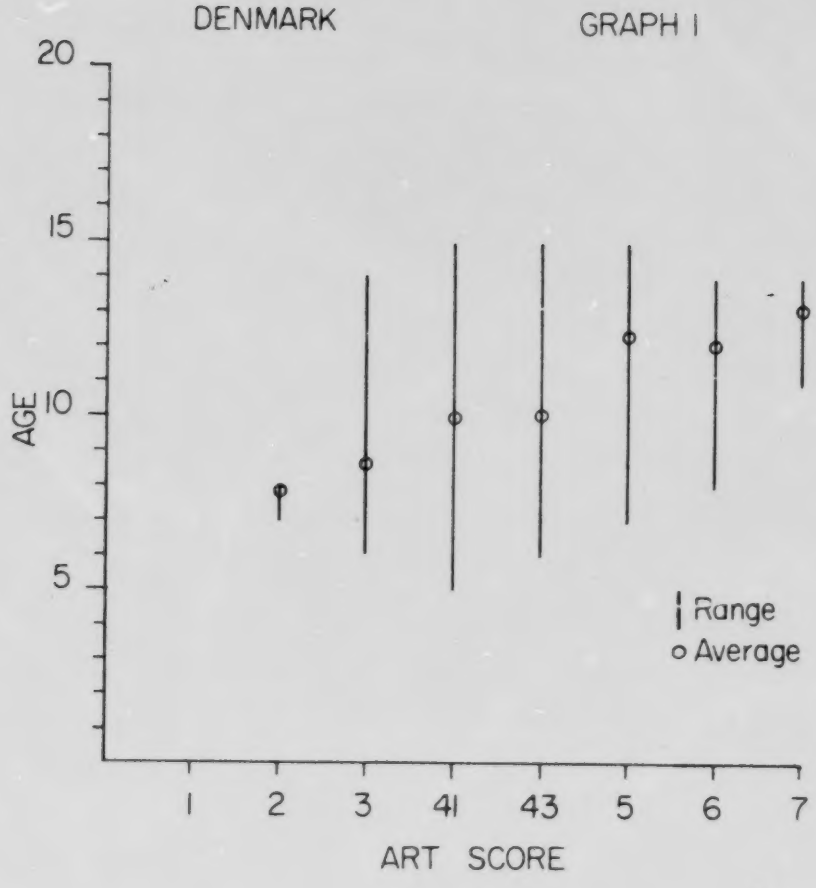
Males:

Art Score	1	2	3	41	Total
Bocca	4	1	0	0	5
Tiriyos	0	5	1	0	6
Cururu	2	6	14	2	24

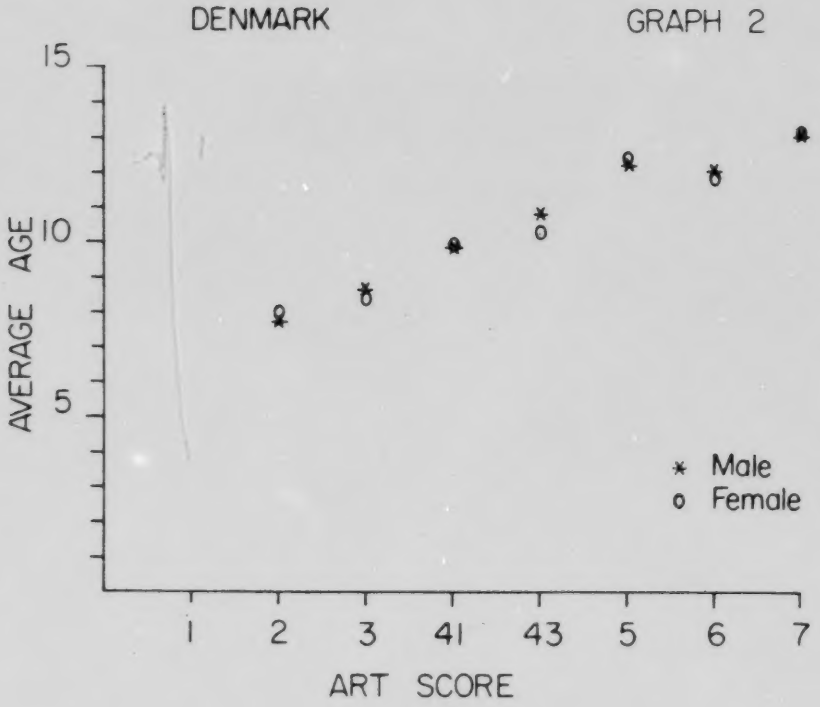
Females:

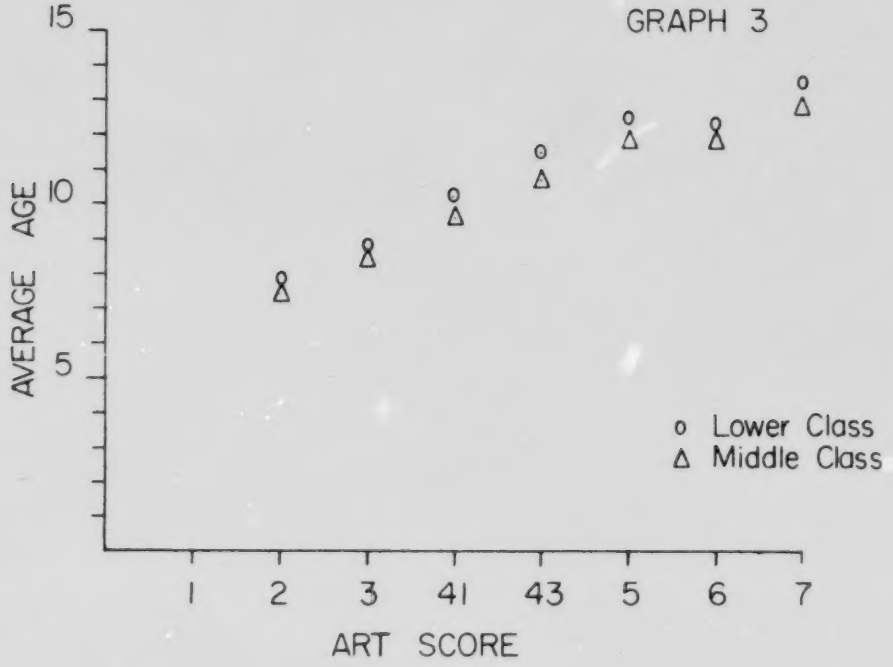
Art Score	1	2	3	41	Total
Bocca	7	5	0	0	12
Tiriyos	0	8	2	0	10
Cururu	8	19	10	0	37

00148

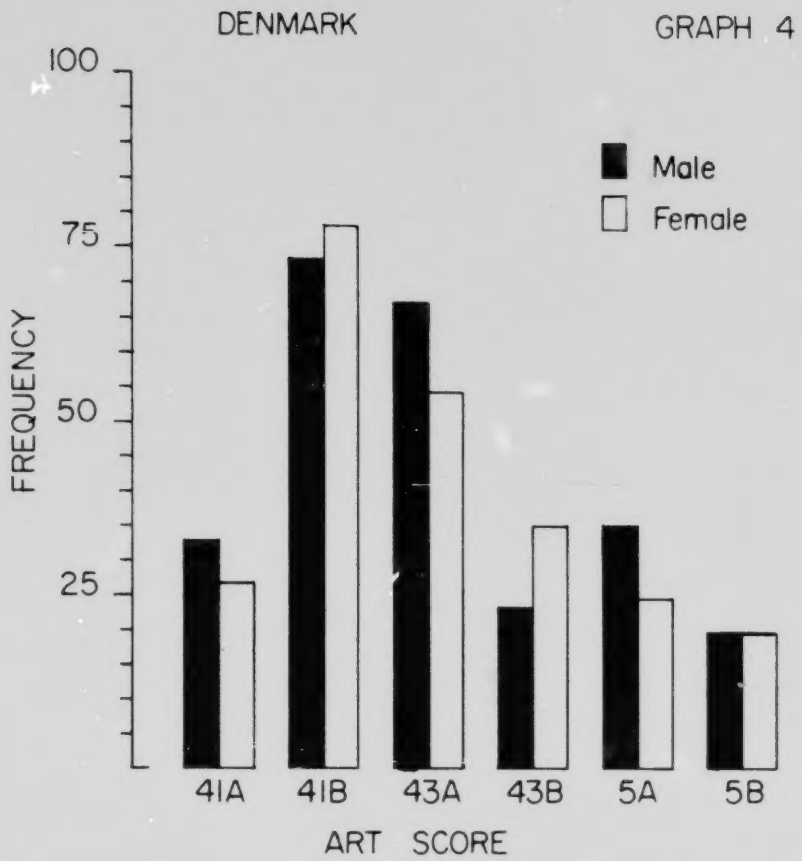

DENMARK
GRAPH I
20
15
10
5
AGE
Range
Average
1
2
3
41
43
5
6
7
ART SCORE

0149


DENMARK
GRAPH 2
15
10
5
AVERAGE AGE
Male
Female
1
2
3
41
43
5
6
7
ART SCORE


GRAPH 3
15
10
5
AVERAGE AGE
Lower Class
Middle Class
1
2
3
41
43
5
6
7
ART SCORE

0150


DENMARK
GRAPH 4
100
75
50
25
FREQUENCY
Male
Female
41A
41B
43A
43B
5A
5B
ART SCORE

00151

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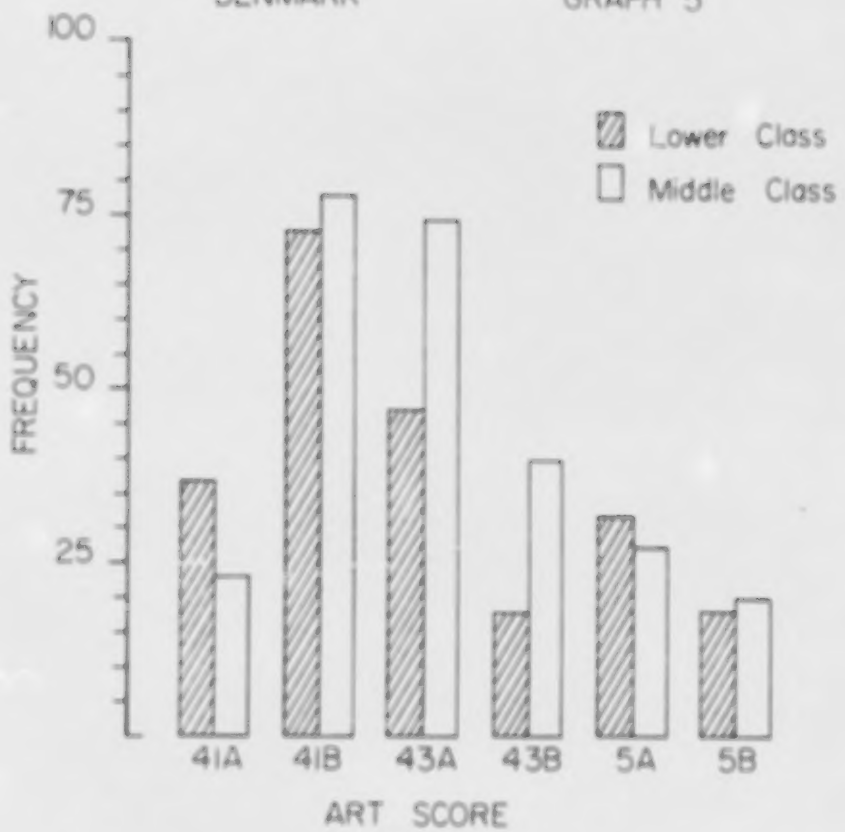
DENMARK GRAPH 5



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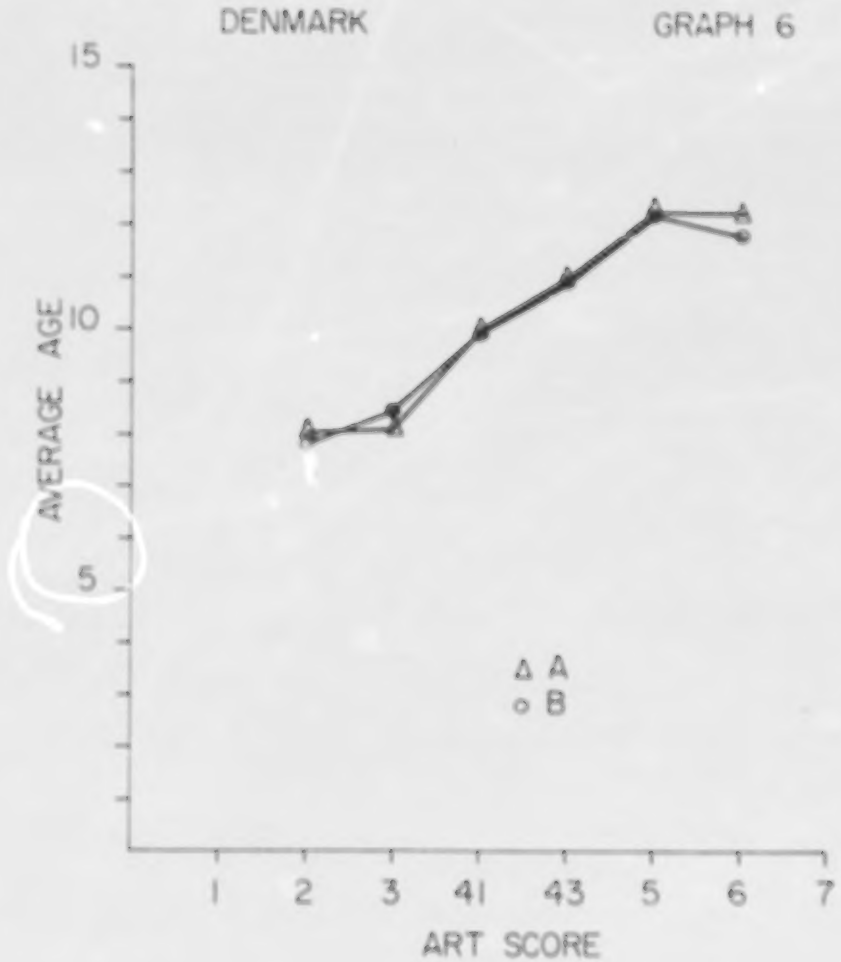

00153

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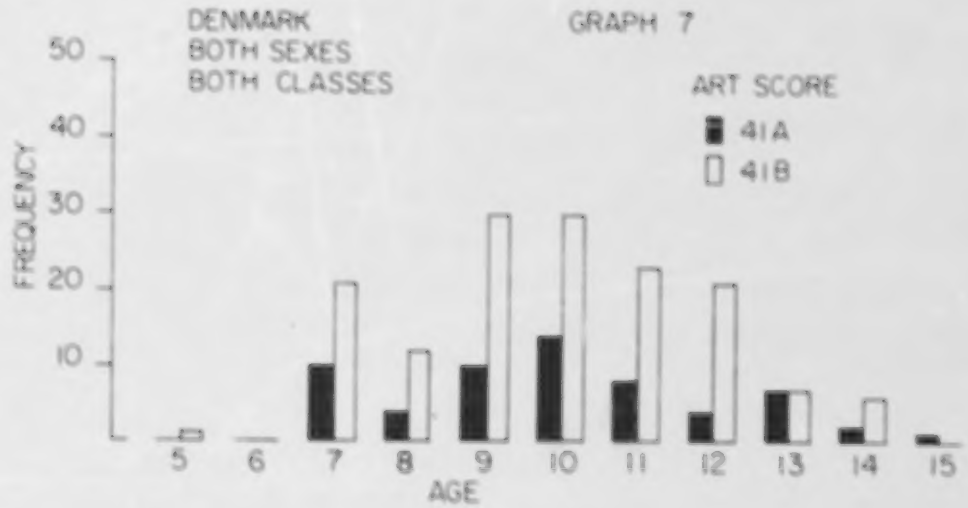

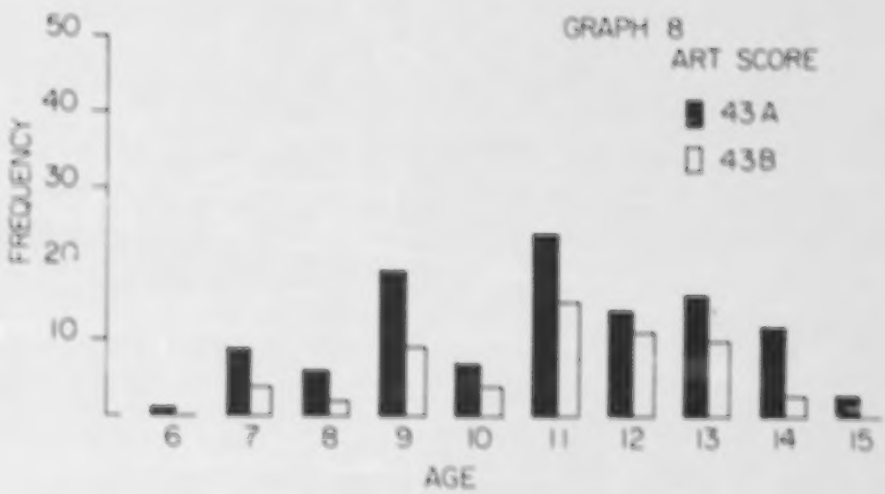

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Denmark, Copenhagen

	Lower	Upper	
Male	202	222	424
Female	196	174	370
	398	396	794

(I) Age vs. Art Score

1(a) Overall population: Average age is approximately an increasing function of art score (Dip at 6 based on 27 observations)

1(b) Lower class: same as in 1(a) (Dip at 6 based on 10 observations)

1(c) Middle class: same as in 1(a) (Dip at 6 based on 17 observations)

1(d) Males: same as in 1(a) (Dip at 6 based on 16 observations)

1(e) Females: same as in 1(a) (Dip at 6 based on 11 observations)

(II) Class Differences

Overall population examined grade by grade. There is a consistently significant difference for each of the grades. Middle class children do significantly better on the art score than do lower class children.

When split on sex: males in fifth grade and females in seventh grade were the only groups not exhibiting the same significant results.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

The following splits showed significant differences (i.e., middle class significantly younger than lower class):

Males with art score 5B

Females with art score 43A
Females with art score 5A
Females with art score 3B
Females with art score 41B
Females with art score 5B

0153

Both sexes combined: Those with art score 43A

3B

41B

5B

(IV) A/B Style Comparisons

(a) 41A/B

No significant differences.

(b) 43A/B

No significant differences.

(c) 5A/B

No significant differences.

00156

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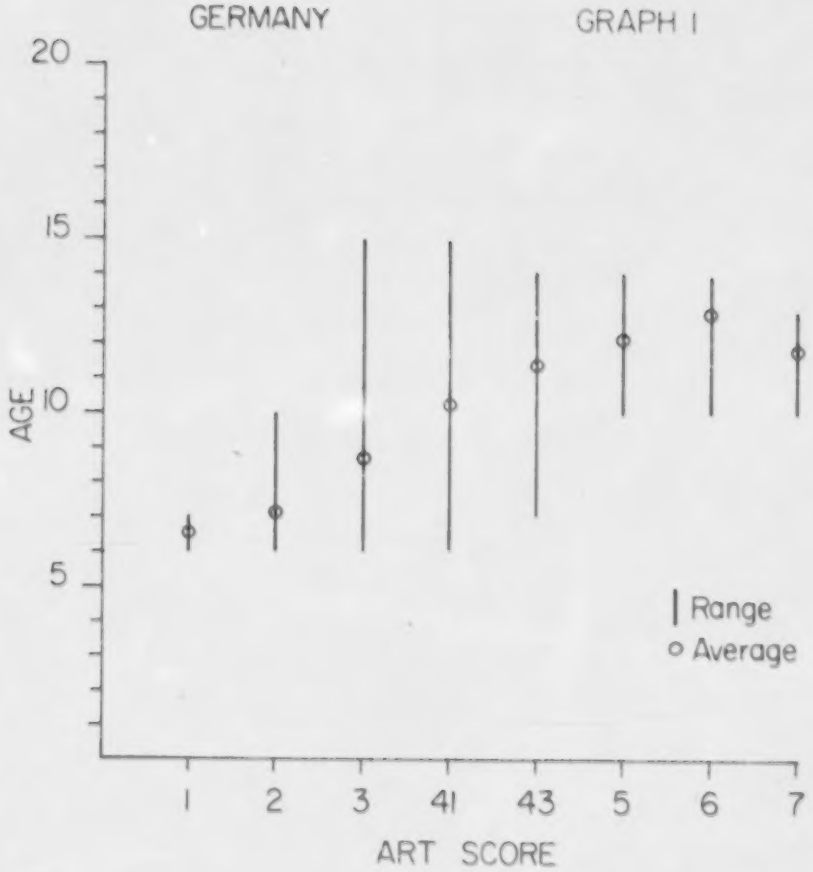

00157

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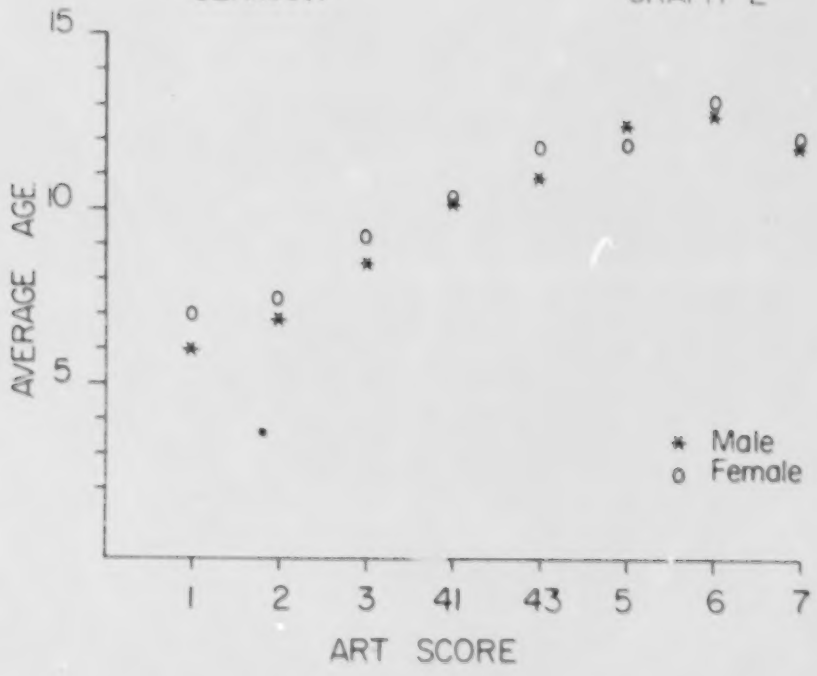
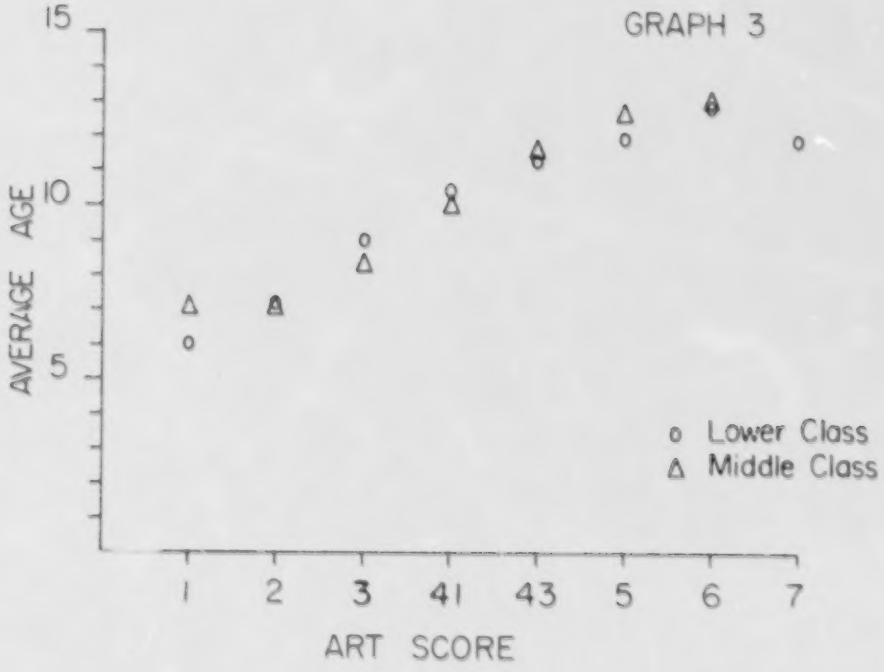
GERMANY

GRAPH 2



GRAPH 3



0158

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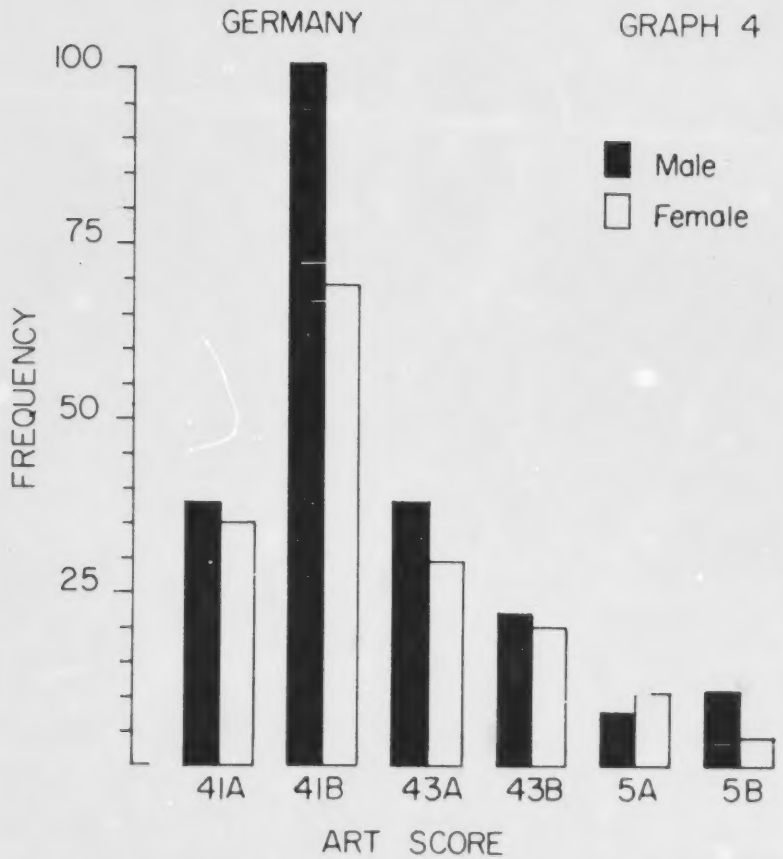

0159

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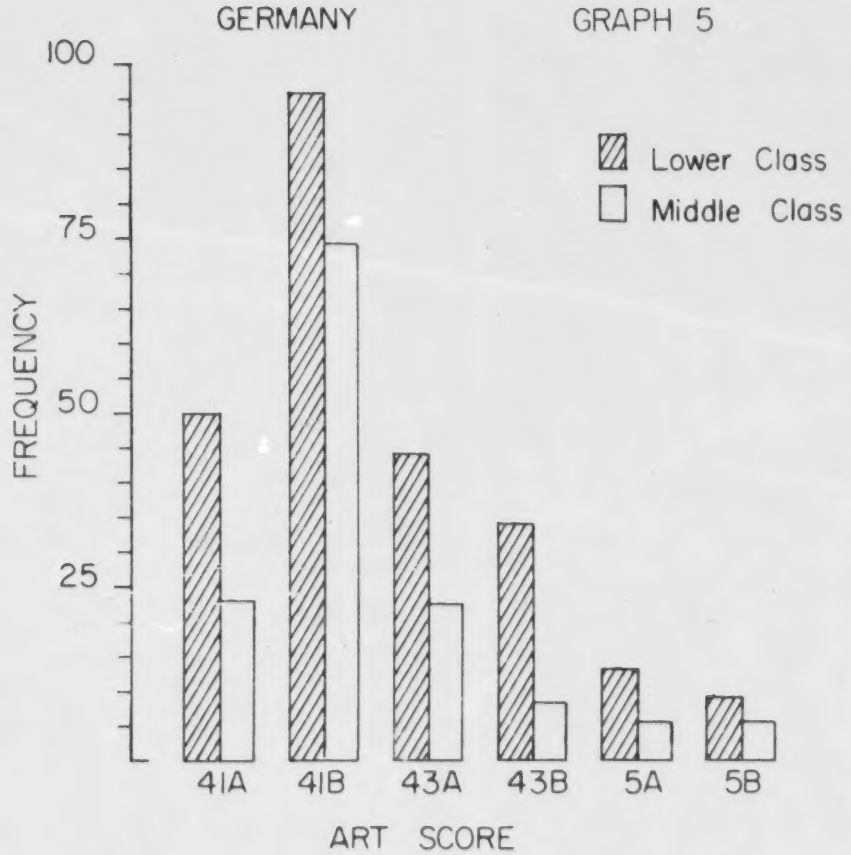

00150

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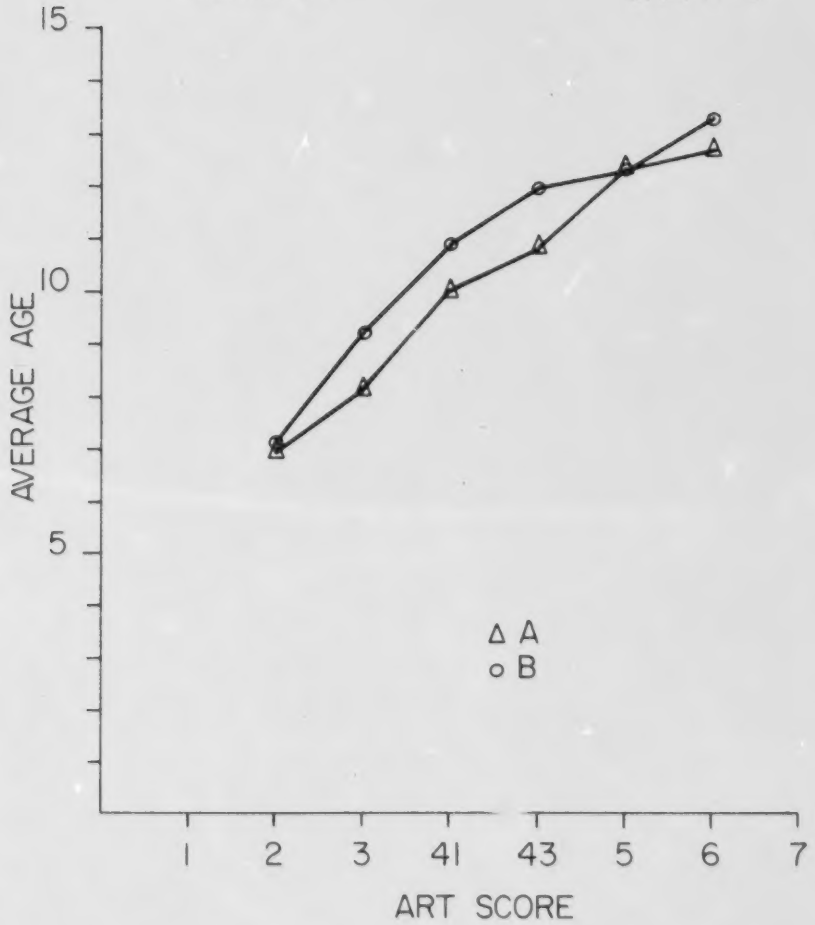
GERMANY GRAPH 6



00161

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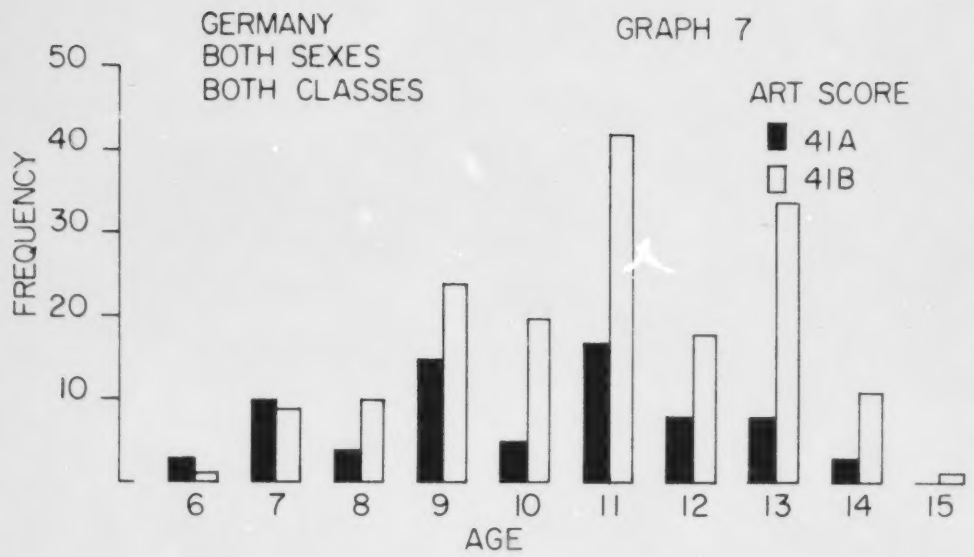

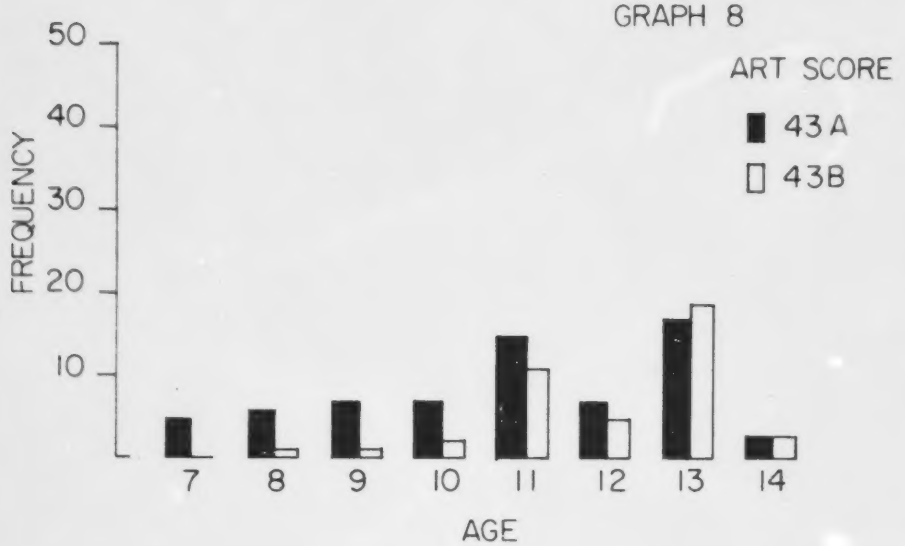

Germany, Saarbrücken

	Lower	Middle	
Male	251	156	407
Female	247	128	375
	498	284	782

(I) Age vs. Art Score

1(a) Total population: average age is almost an increasing function of art score (Dip at score 7 based on 6 observations)

1(b) Lower class: same as in 1(a) (Dip at score 7 based on 6 observations)

1(c) Middle class: average age is an increasing function of art score

1(d) Males: same as in 1(a) (Dip at 7 based on 5 observations)

1(e) Females: same as in 1(a) (Dip at 7 based on 1 observation)

(II) Class Differences

Examined grade by grade by looking at art score. No significant results at all.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

The middle class was significantly older than the lower class for the following cases:

Both sexes combined: 43B and 5B

Males: 43B and 5B

Middle class children were significantly younger than lower class for the following cases:

Both sexes combined: 3A

Females: 41B

(IV) A/B Style Comparisons

(a) 41A/B

41B's were significantly older than 41A's for the following cases: Overall population, females and lower class females.

00163

(b) 43A/B

43B's were significantly older than 43A's for the following cases: overall population, males, lower class, middle class, middle class males.

(c) 5A/B

No significant differences.

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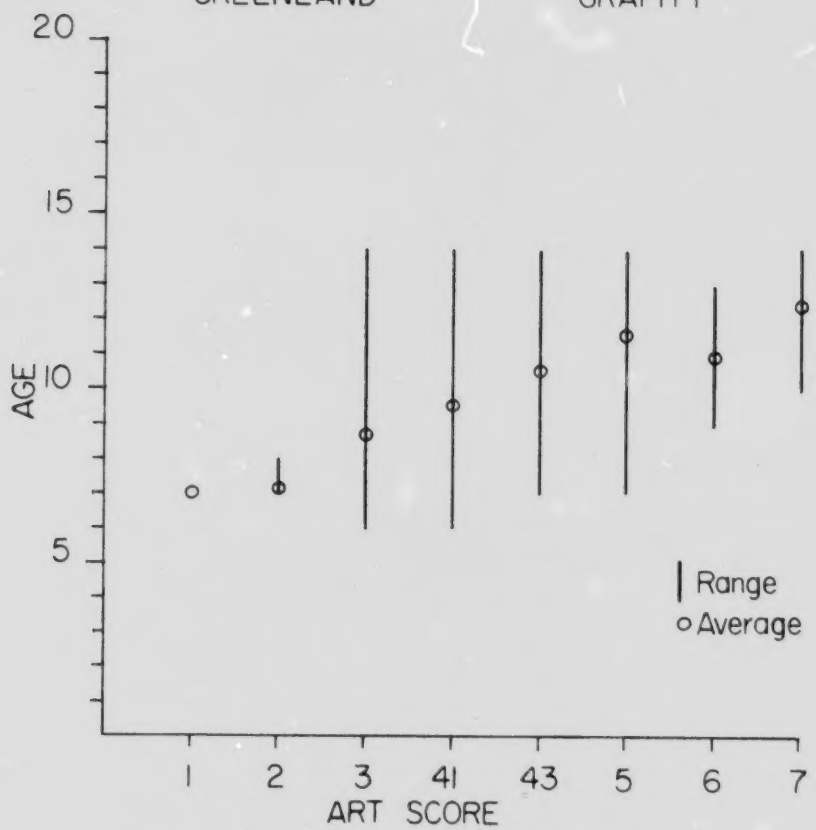
GREENLAND GRAPH I



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GREENLAND

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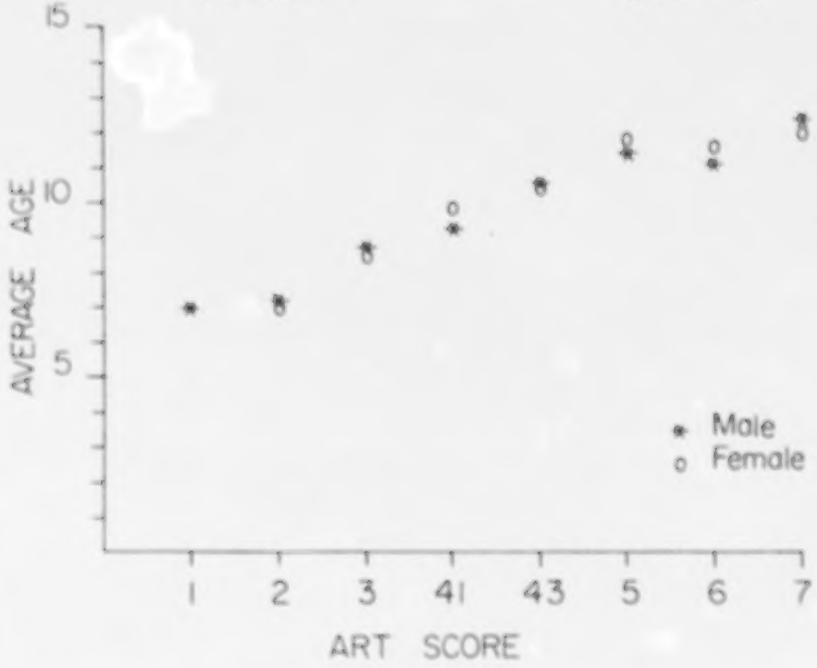

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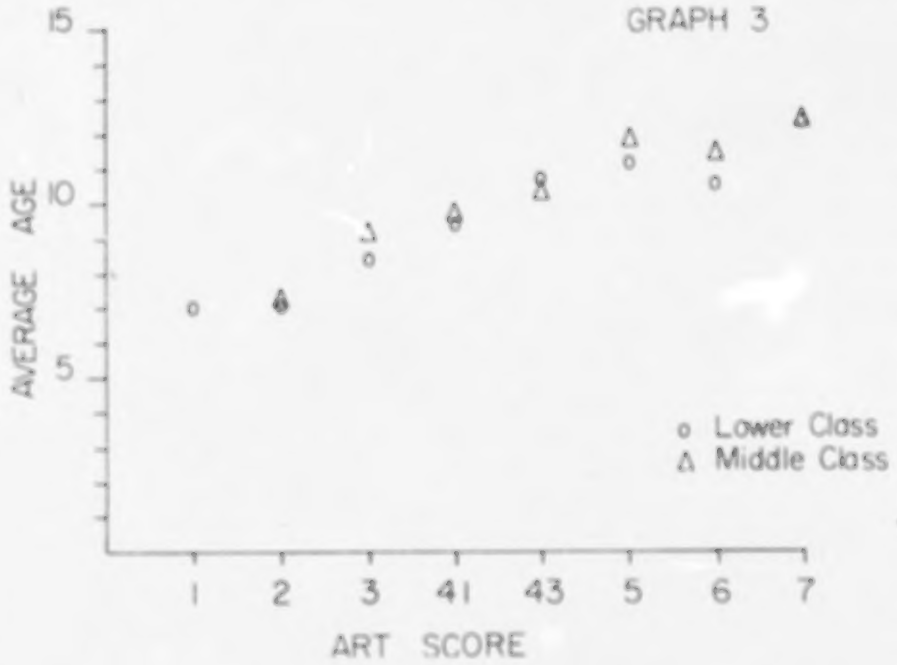

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GREENLAND

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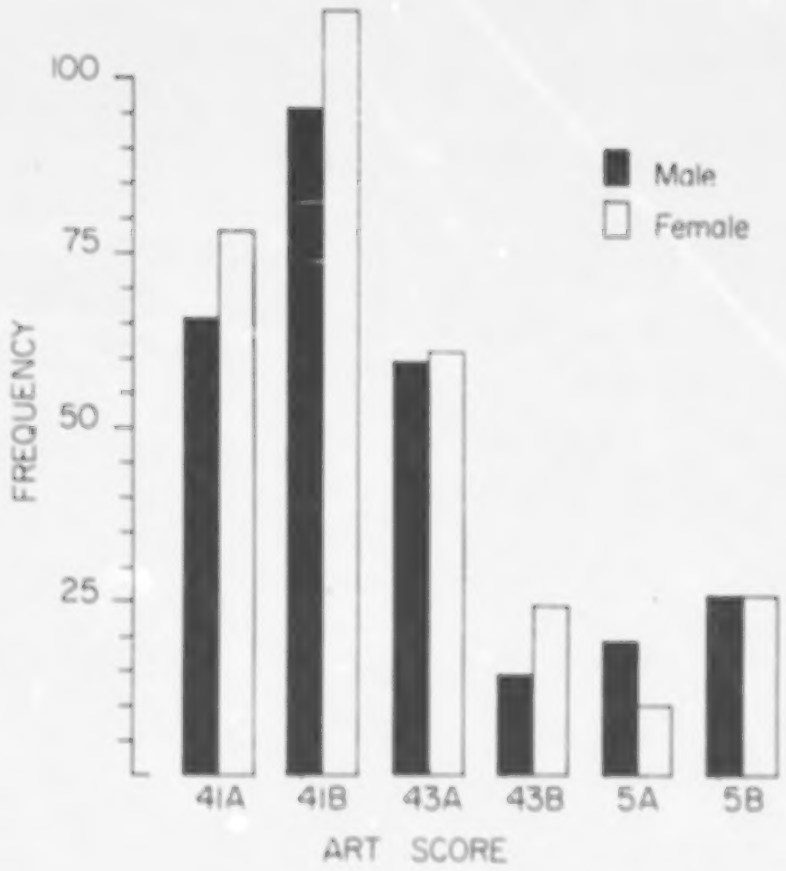

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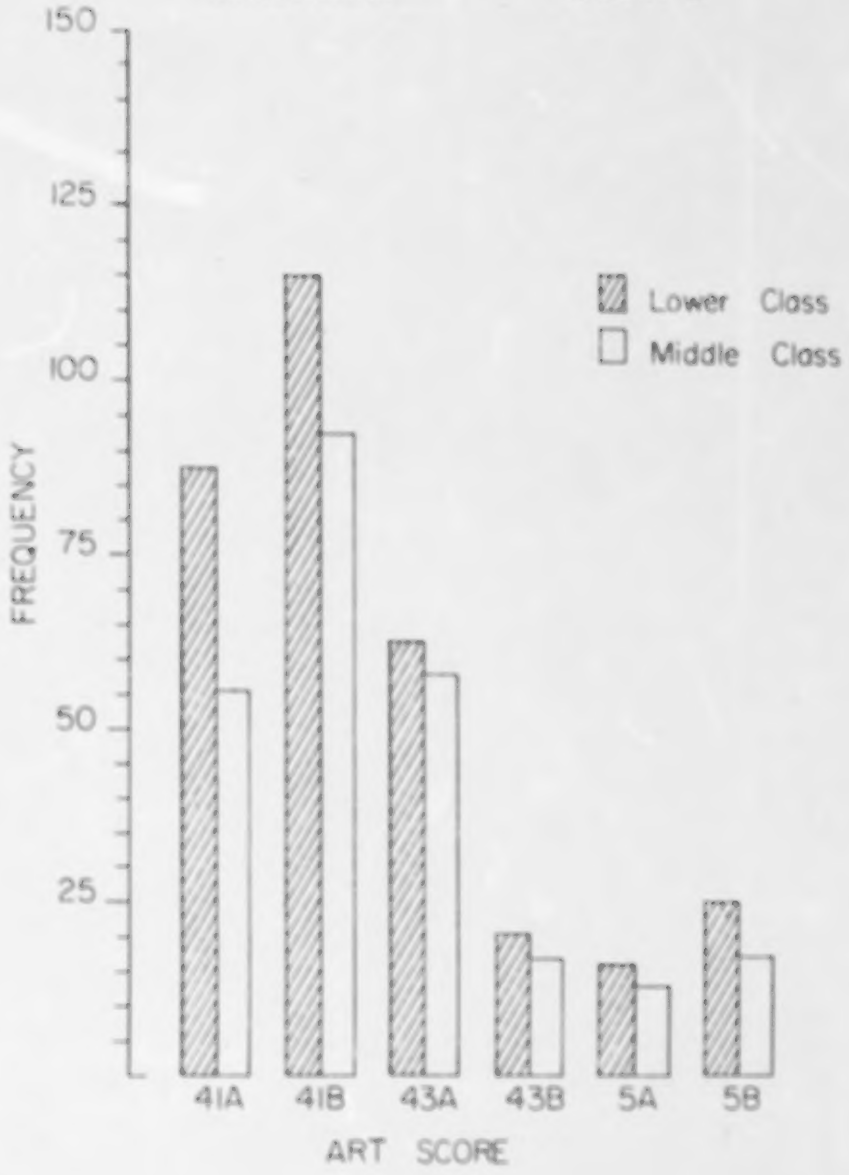

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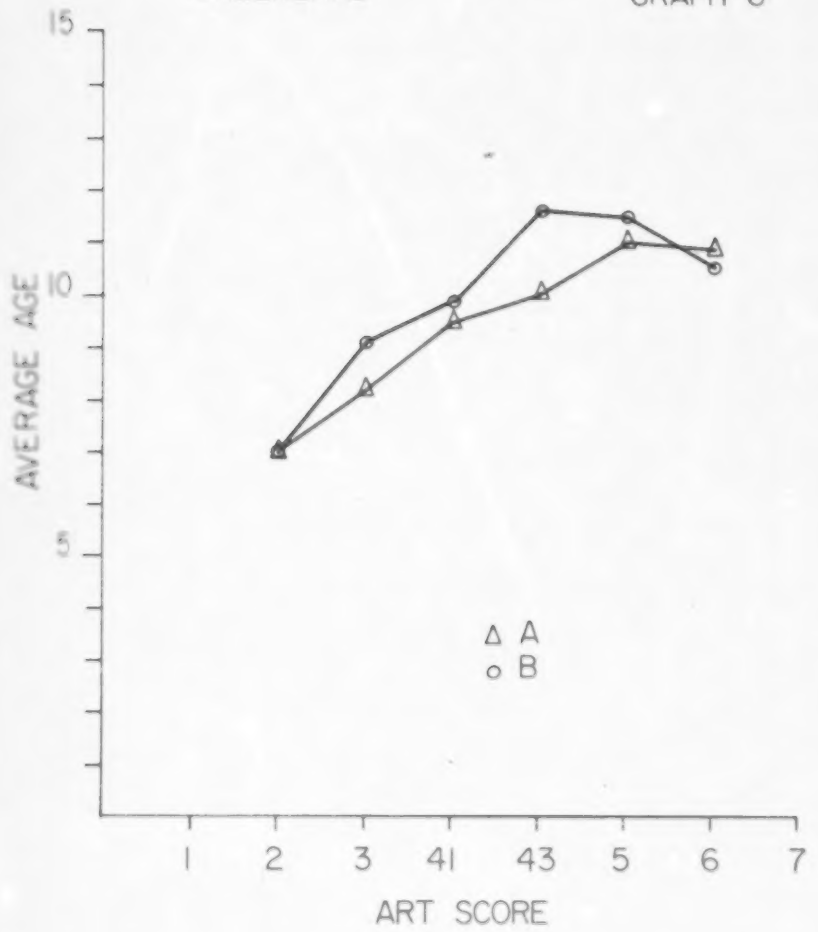

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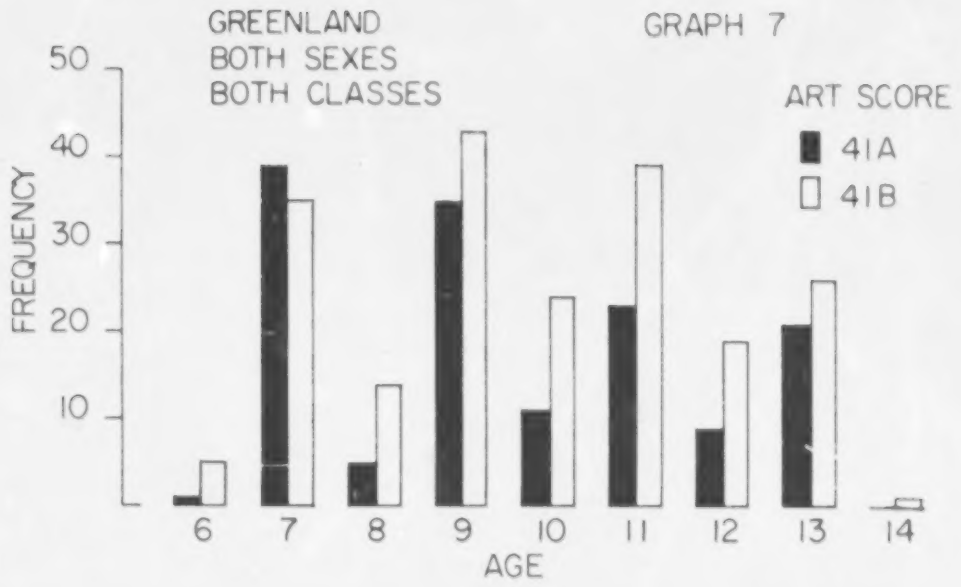

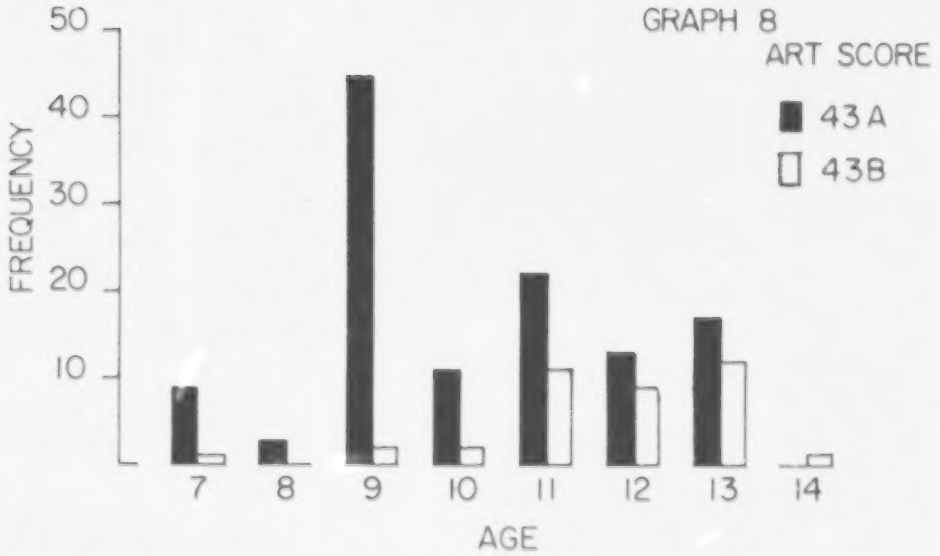

00170

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Greenland

	Lower	Middle	
Male	239	163	402
Female	219	191	410
	458	354	812

(I) Age vs. Art Score

1(a) Total population: average age is approximately an increasing function of art score (only exception is a dip at score 6 based on sample of 12 children at 6)

1(b) Lower class: same conclusion as 1(a). (8 children at 6)

1(c) Middle class: same conclusion as 1(a) (4 children at 6)

1(d) Males: same conclusion as 1(a) (7 children at 6)

1(e) Females: same conclusion as 1(a) (5 children at 6)

(II) Class Differences

Overall population examined grade by grade: There were No significant differences between lower and middle class children.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

Both sexes combined: for 43A's the lower class children were significantly older than the middle class ones.

The same was true for 43A females.

Both sexes combined: for 5B types the middle class was significantly older than the lower class.

(IV) A/B Style Comparisons

(a) 41A/B

No significant results.

(b) 43A/B

Overall population: 43B types are significantly older than 43A types (estimated shift 2 years).

When split by sex and class the same result continues to hold for every combination of sex and class except lower class males (where the results are not significant).

(c) 5A/B

No significant results.

00171

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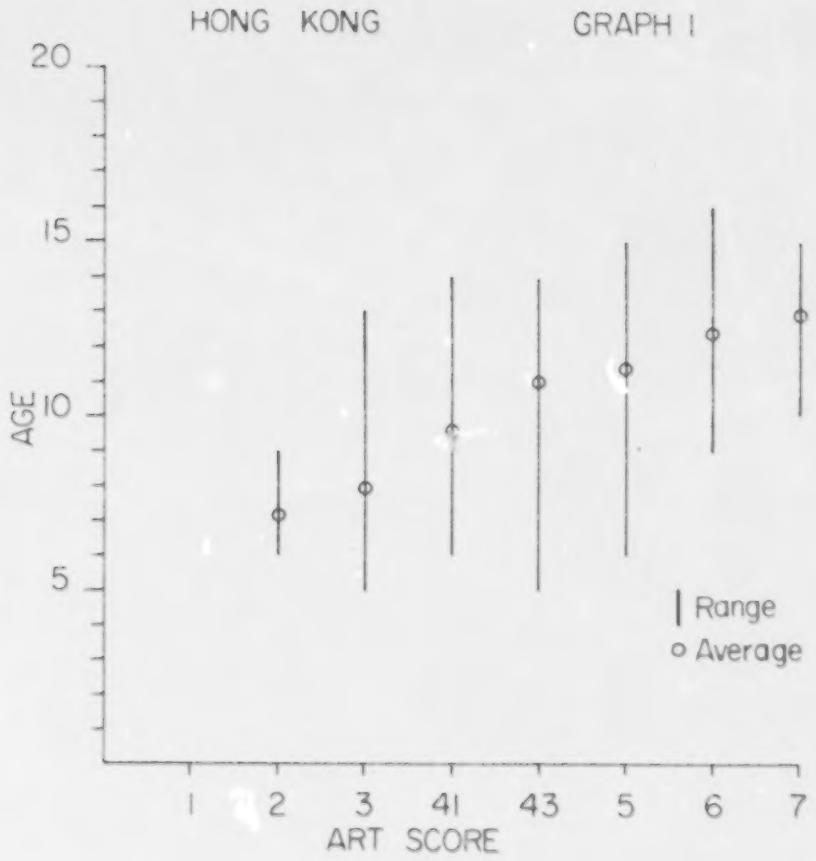

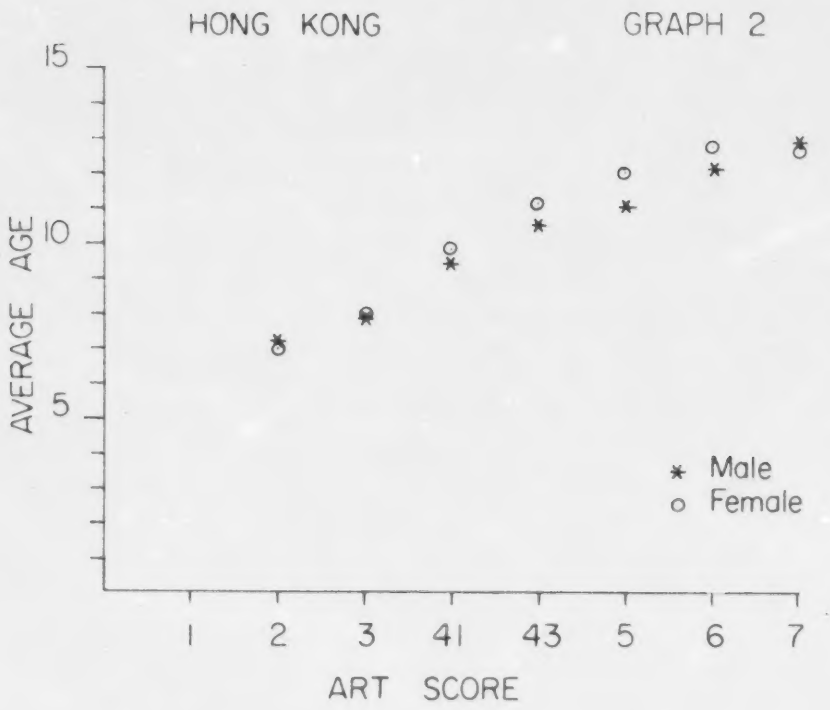
HONG KONG
GRAPH 2
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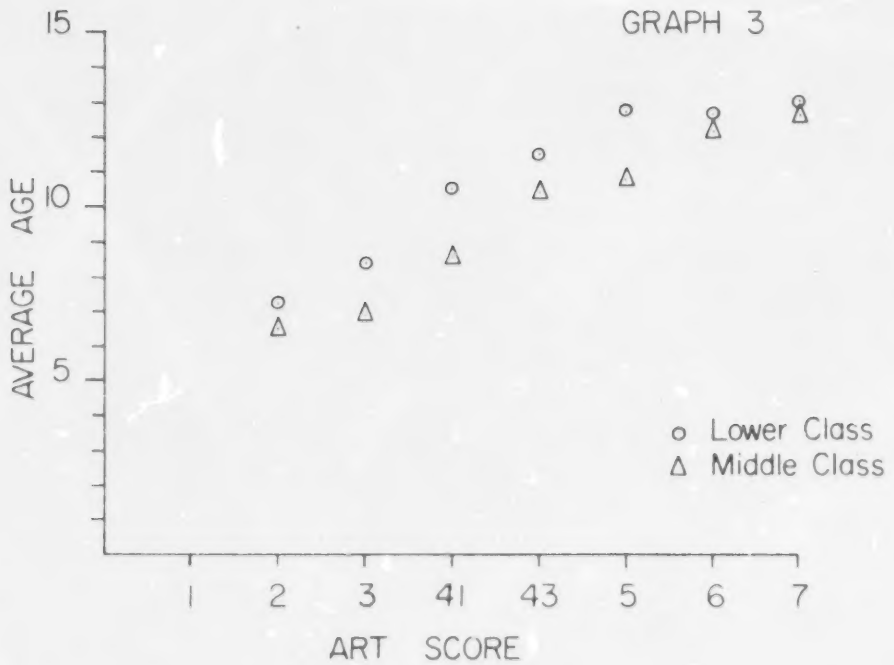
10
5
AVERAGE AGE
Male
Female
1
2
3
41
43
5
6
7
ART SCORE


GRAPH 3
15
10
5
AVERAGE AGE
Lower Class
Middle Class
1
2
3
41
43
5
6
7
ART SCORE

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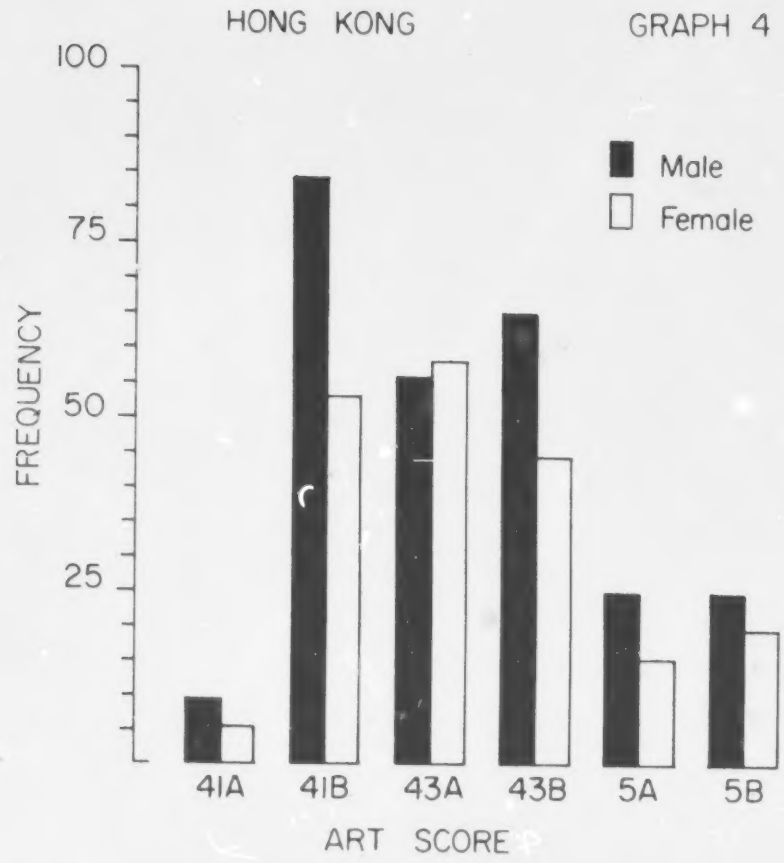

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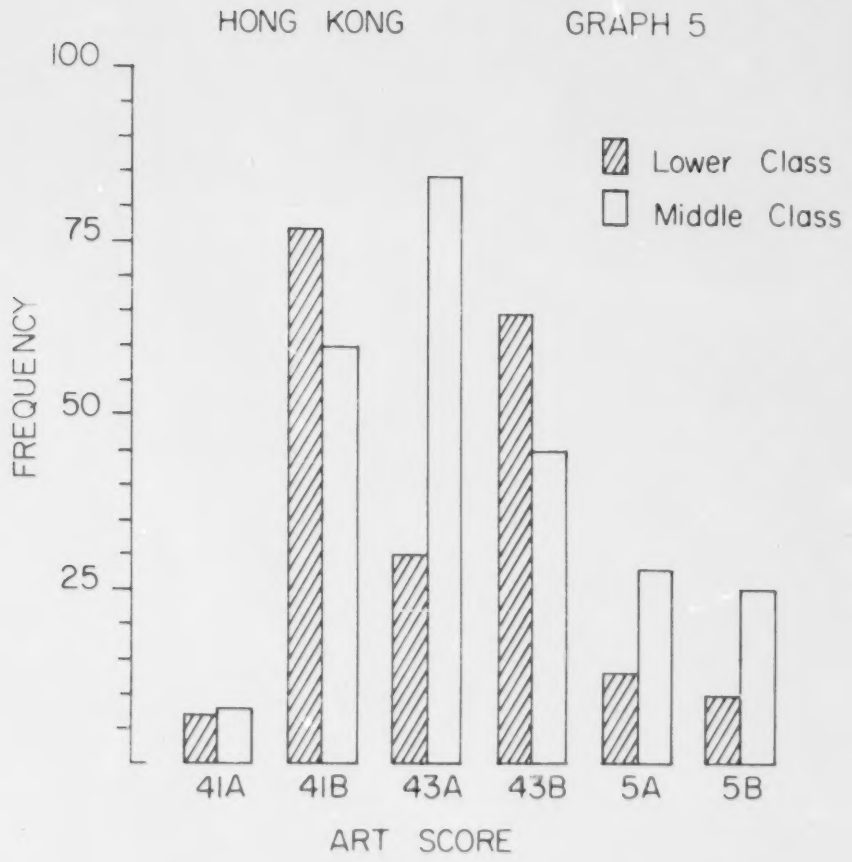

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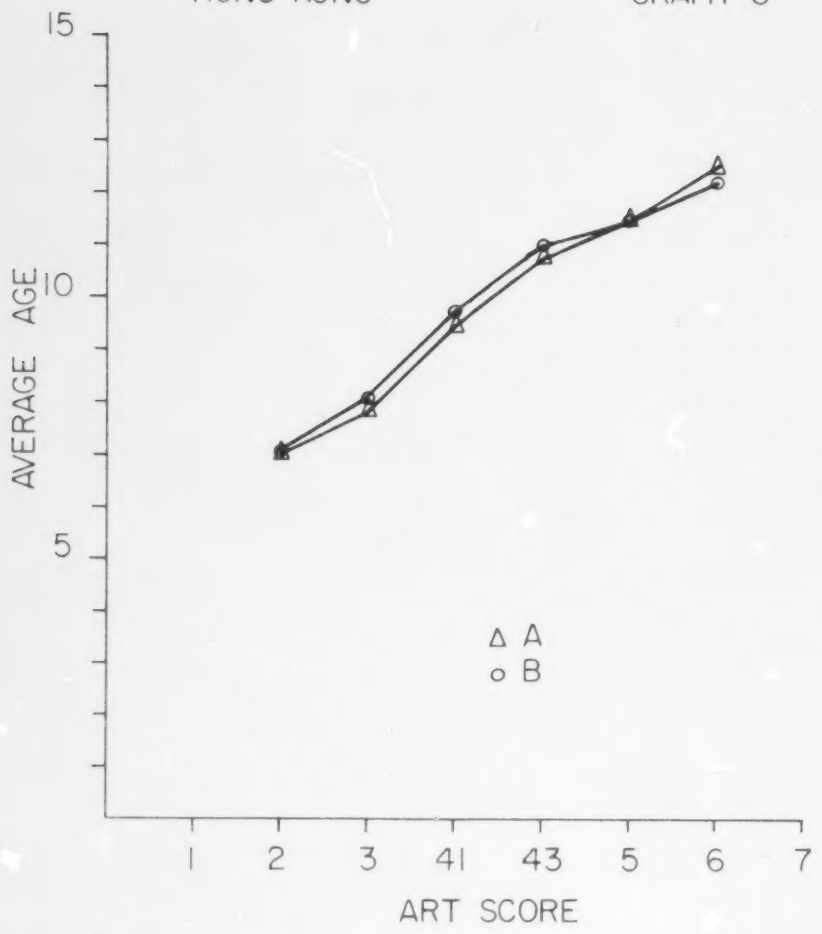
HONG KONG GRAPH 6



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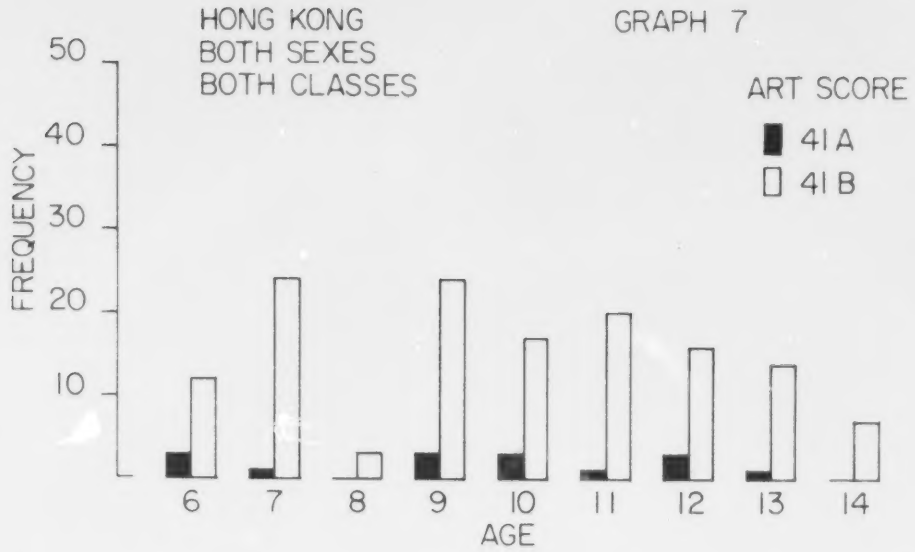

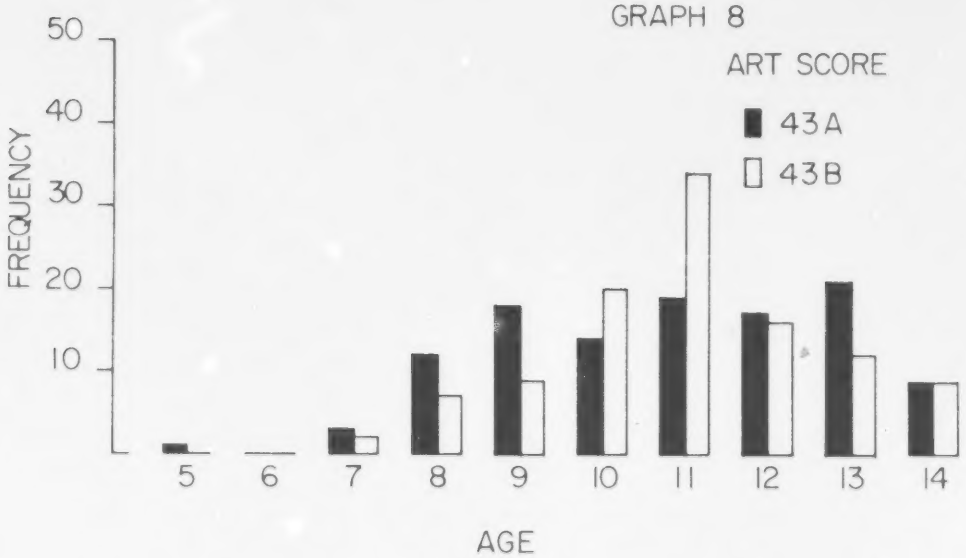

00177

HONG KONG

GRAPH 9

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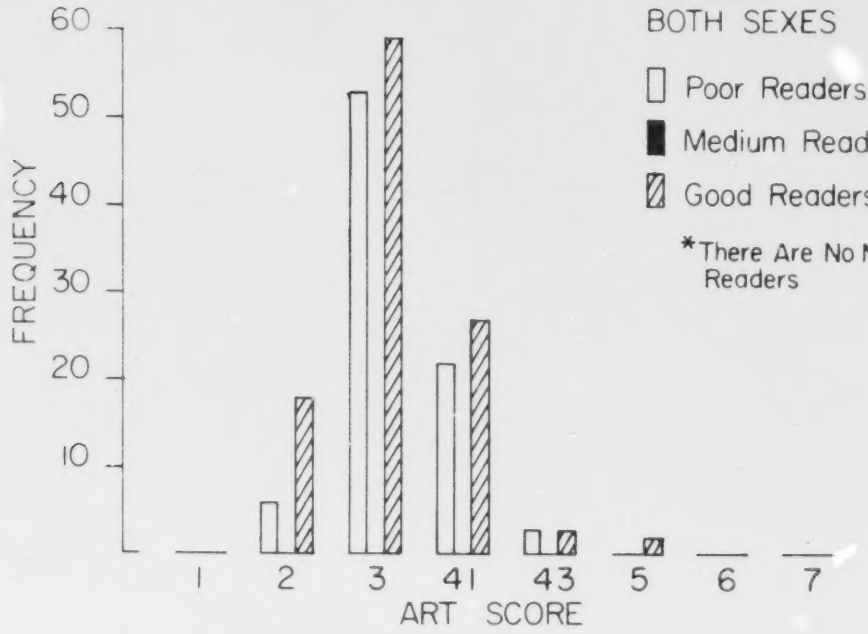
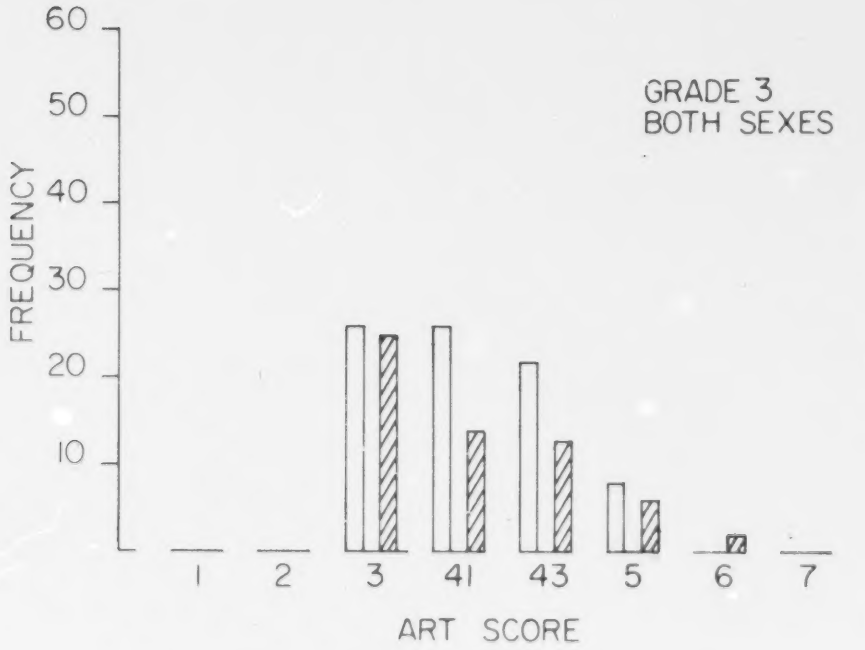
BOTH SEXES





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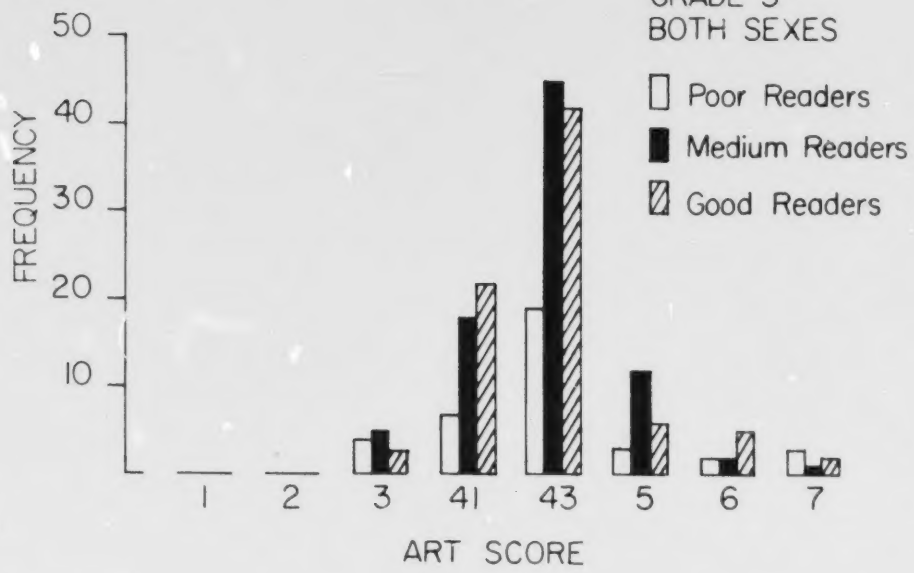
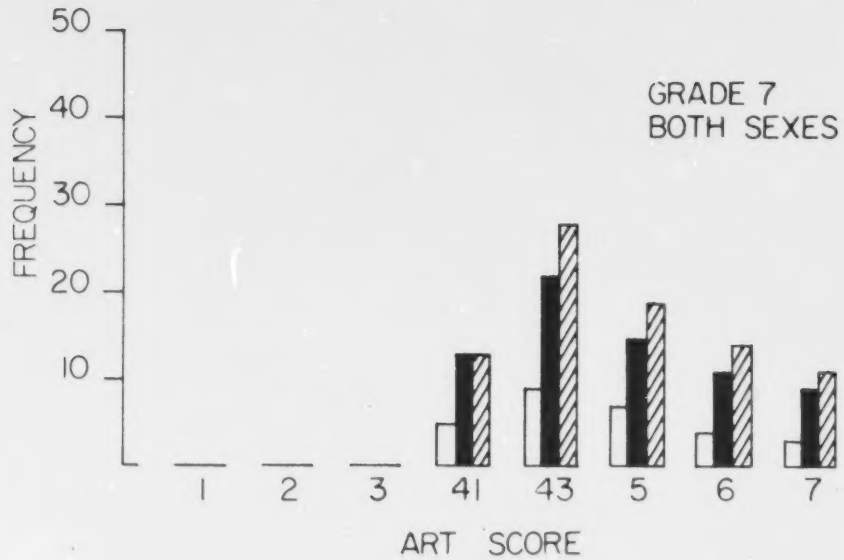
HONG KONG

GRAPH 9

GRADE 5
BOTH SEXES



GRADE 7
BOTH SEXES



0179

Hong Kong, Kowloon

	Lower	Middle	
Male	202	237	439
Female	178	116	294
	380	353	723

(I) Age vs. Art Score

1(a) Total population: sequence increases with art score

1(b) Lower class: almost increasing (Dip at 6 based on 20 observations)

1(c) Middle class: average age increases with art score

1(d) Males: average age increases with art score

1(e) Females: almost increasing (Dip at 7 based on 4 observations)

(II) Class Differences

There is a very significant shift (the middle class having higher art scores) for grades 1, 3 and 5. When split on each sex the same result is true both for males alone and females alone.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

Do the middle class children tend to be younger when compared with lower class children having the same art score? Yes, significantly so for the following cases:

Both sexes combined: those with art scores 3B, 41A, 41B, 43A, 43B, 5A and 5B

Males alone: those with art scores 3B, 41A, 41B, 43A, 43B, 5A and 5B

Females alone: those with art scores 3B, 41B and 43B

(IV) A/B Style Comparisons

(a) 41A/B

No significant results.

(b) 43A/B

Males having 43B tend to be significantly older than those having art score 43A. Females in the middle class having 43B tend to be significantly younger than those with 43A.

(V) Reading Score Comparisons

Do better readers tend to have higher art scores?

Total population: no significant results in any of the grades 1, 3, 5 or 7

However, note that in grades 1 and 3 there were no medium readers and the special tests for ordered alternatives discussed in the introductory section, "Discussion of Analysis," were not carried out by the computer.

Are poor readers older when compared to better ones with the same art scores? No significant results for any of the art scores.

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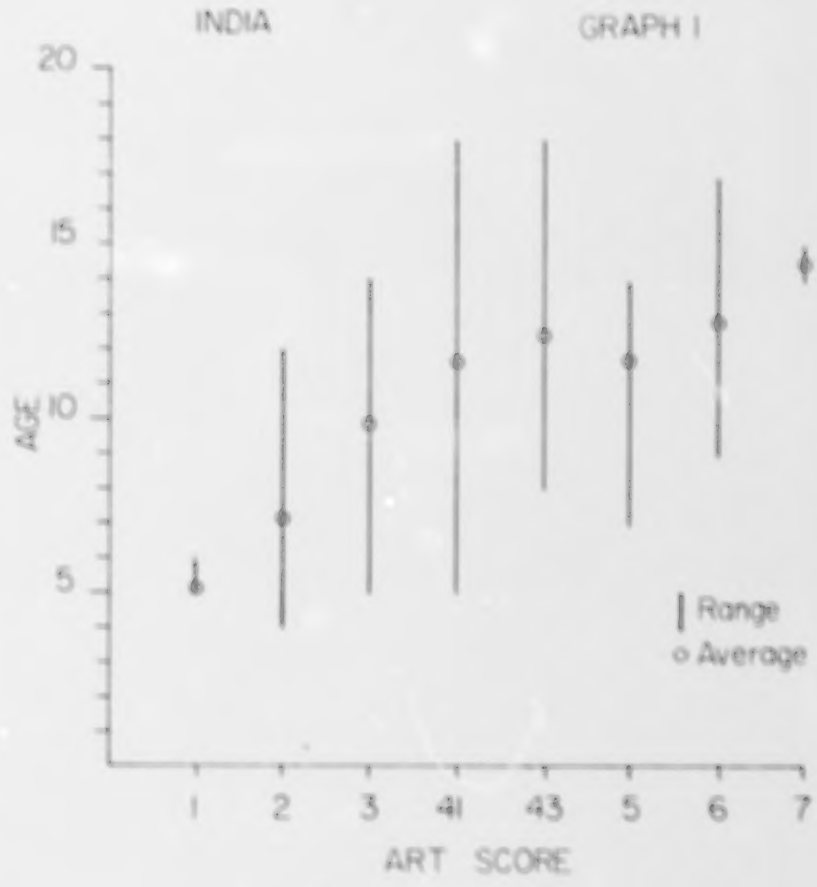

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INDIA

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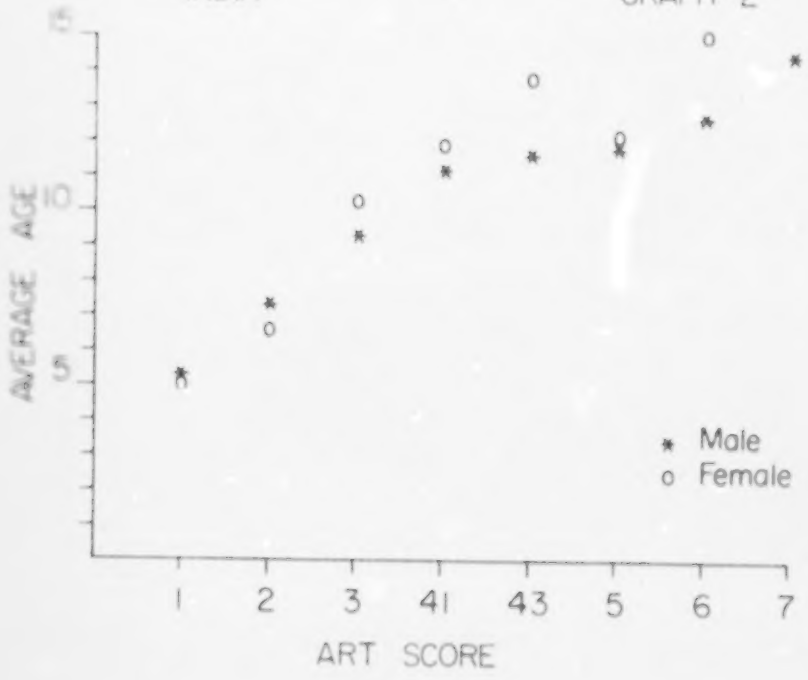

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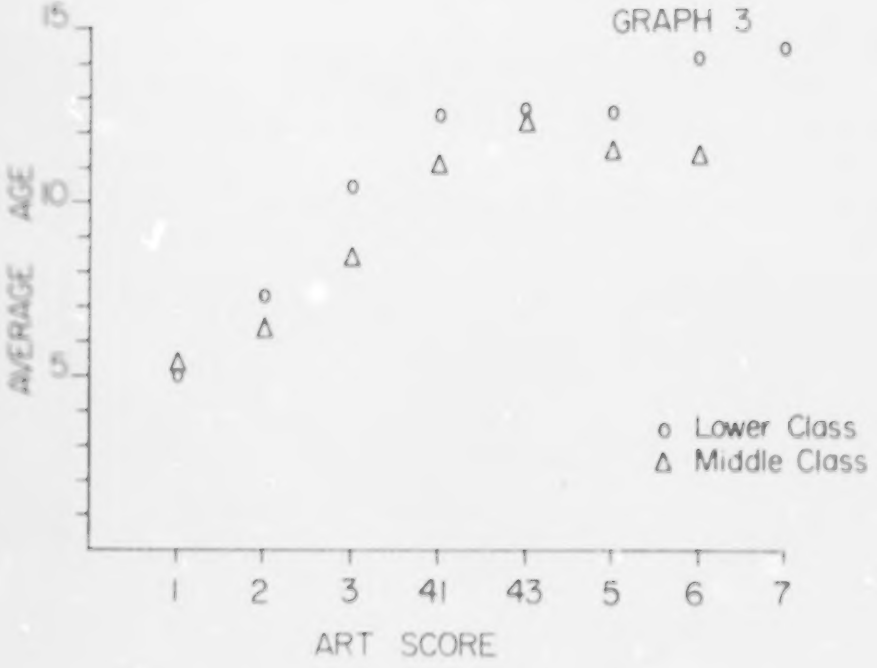

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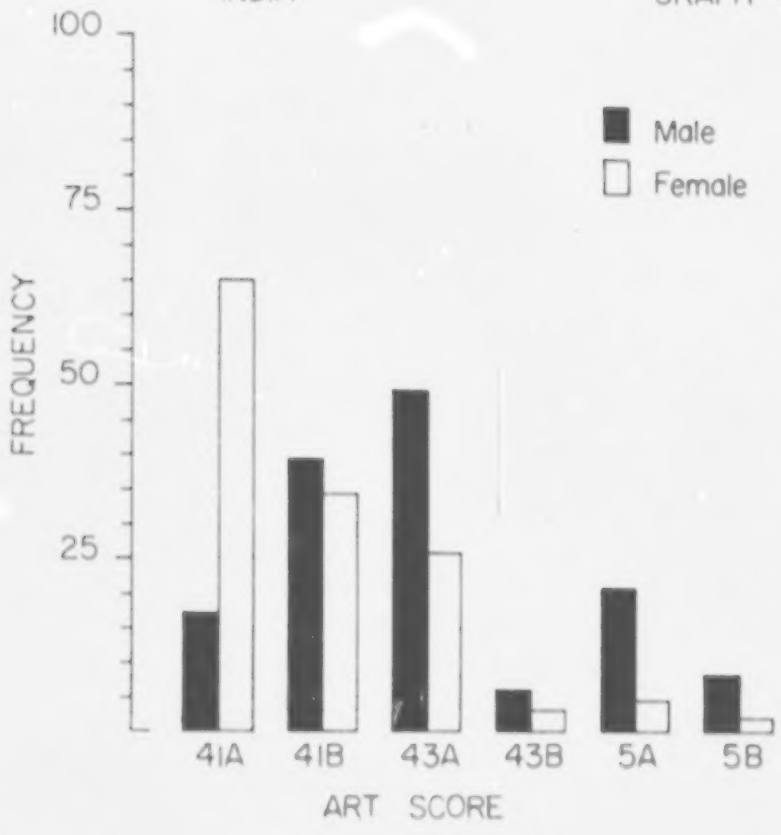

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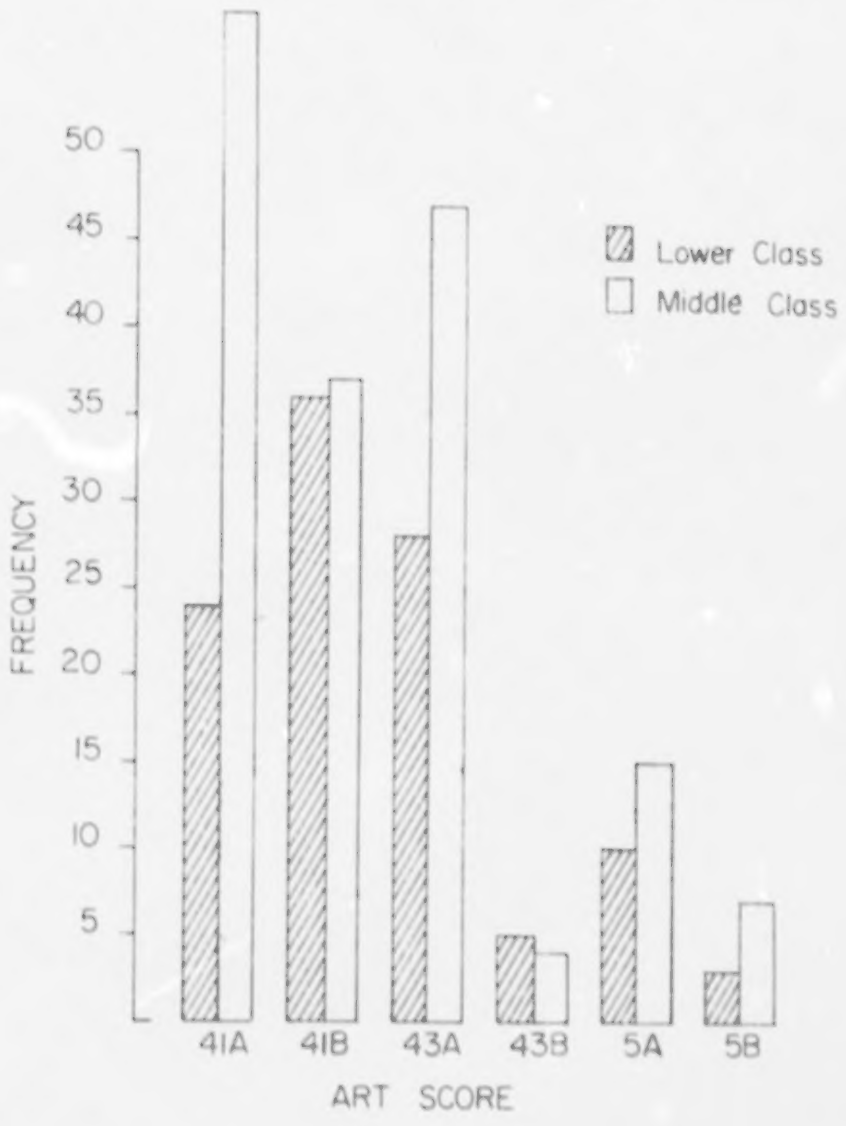

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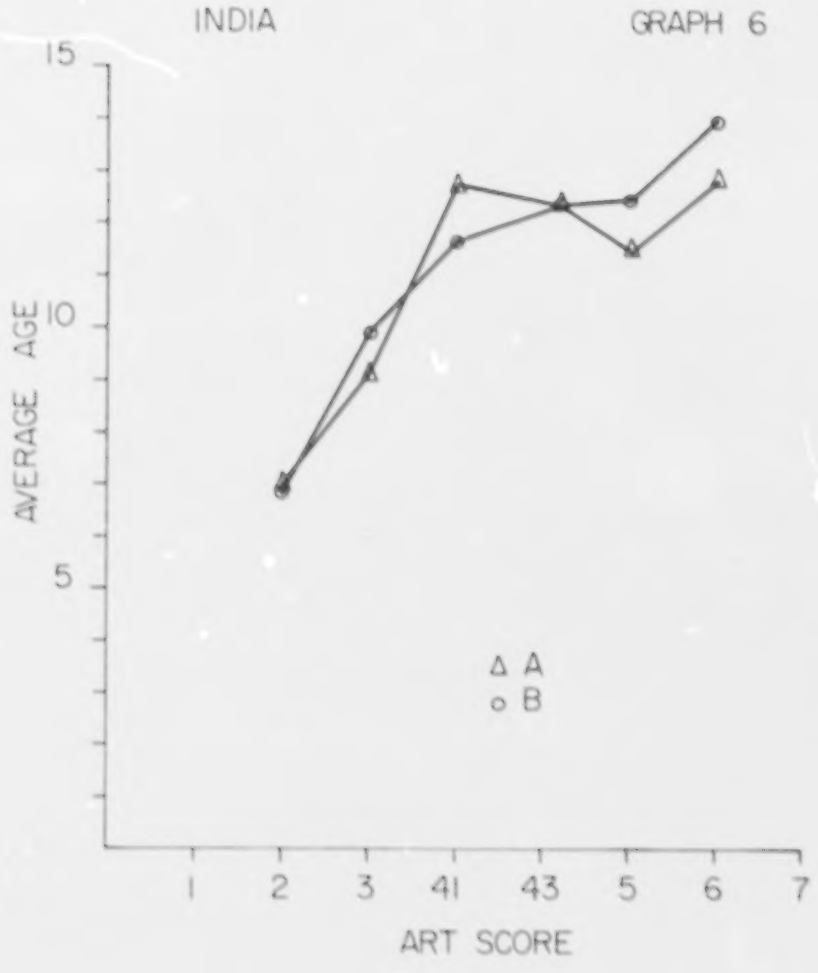

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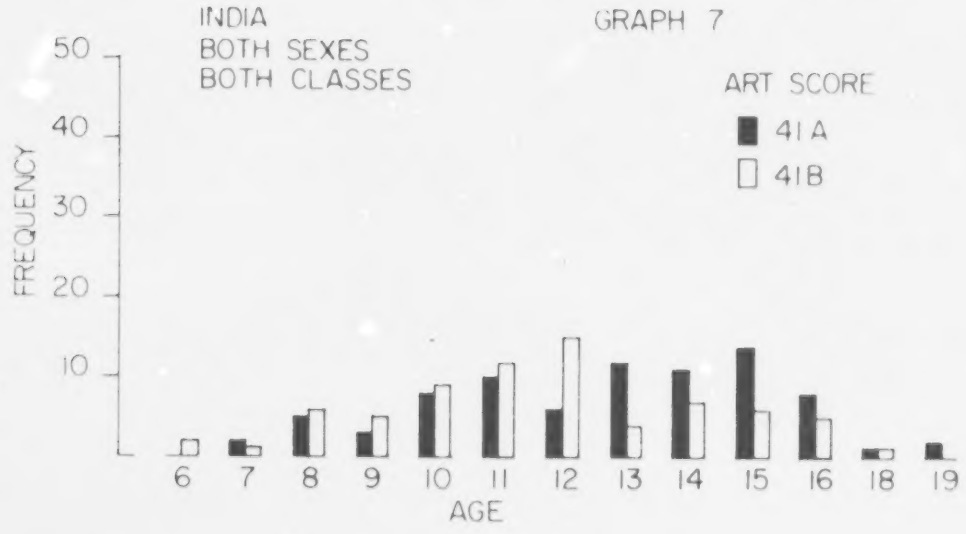

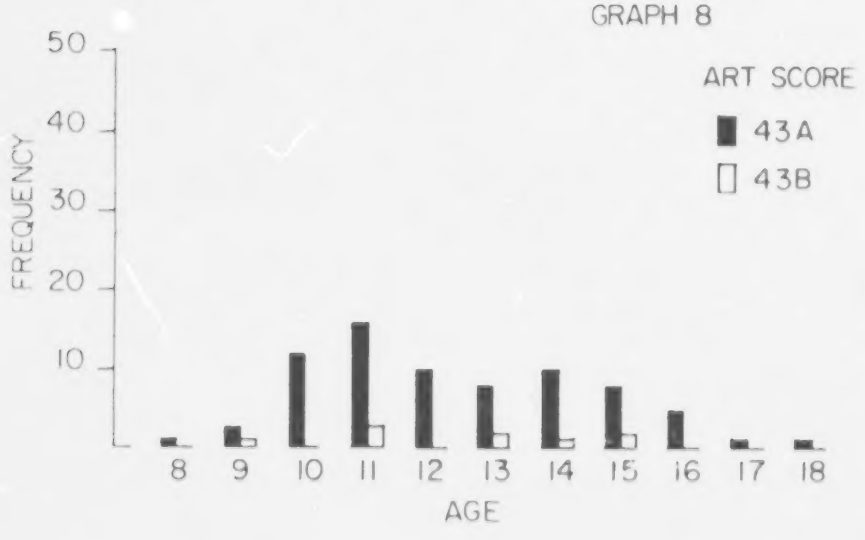

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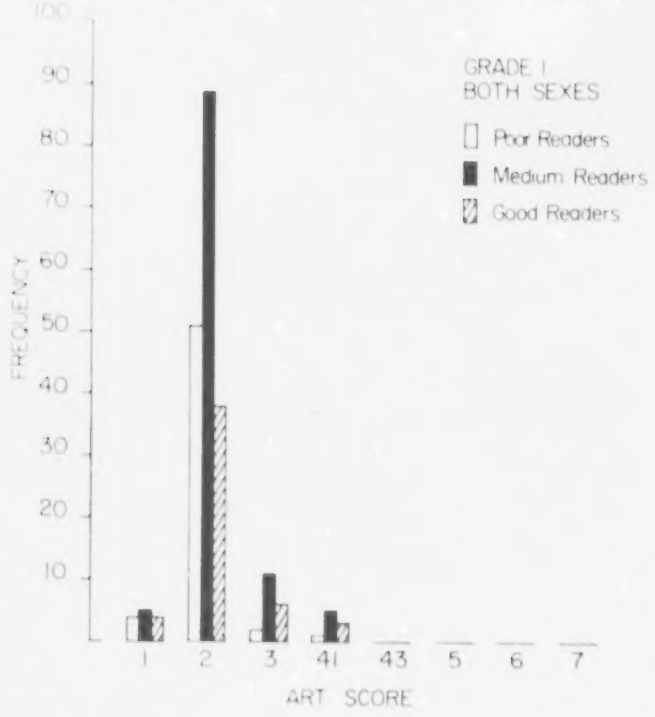

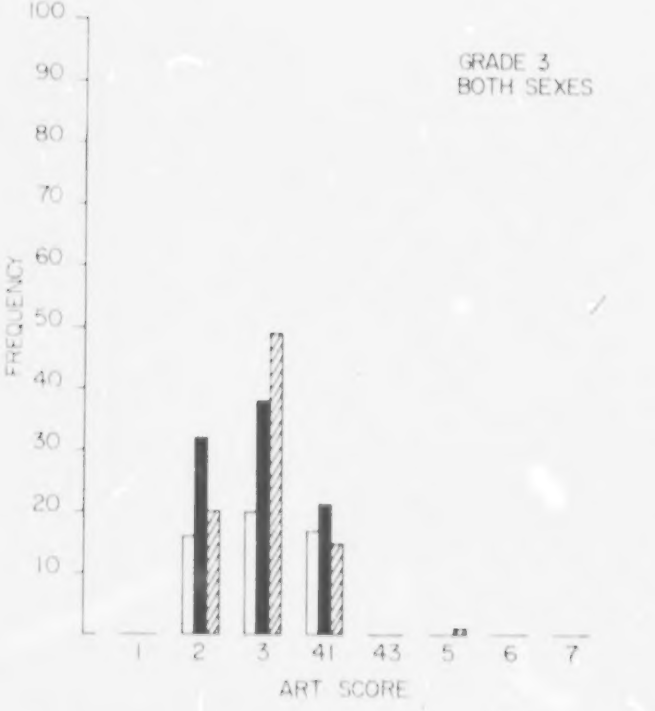

20188

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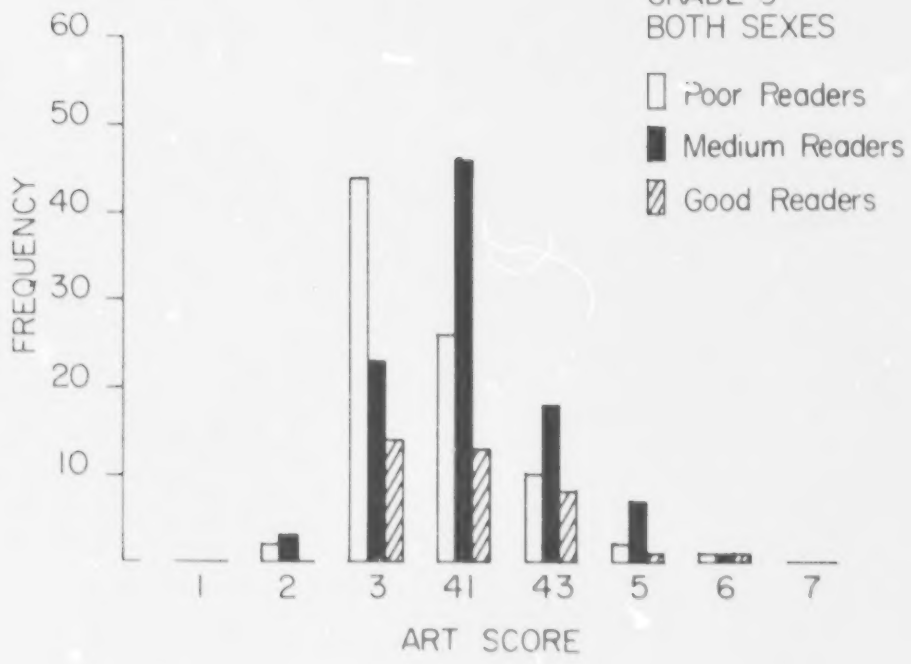
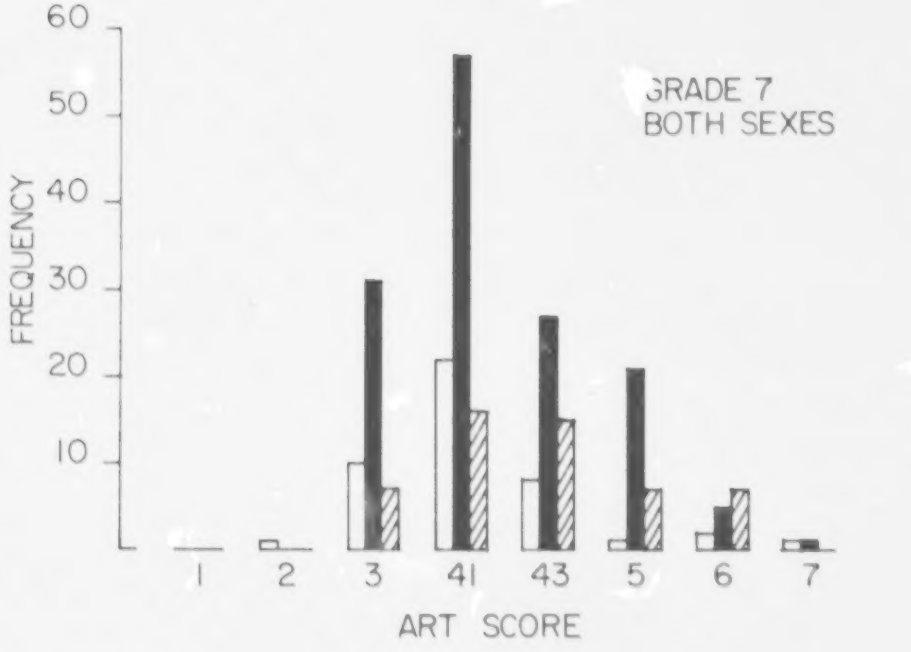
GRAPH 9

GRADE 5
BOTH SEXES





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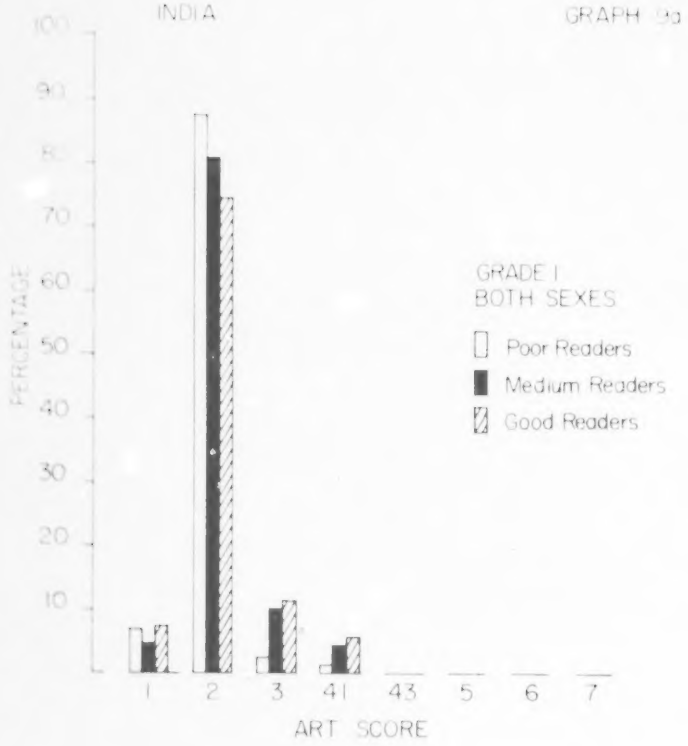

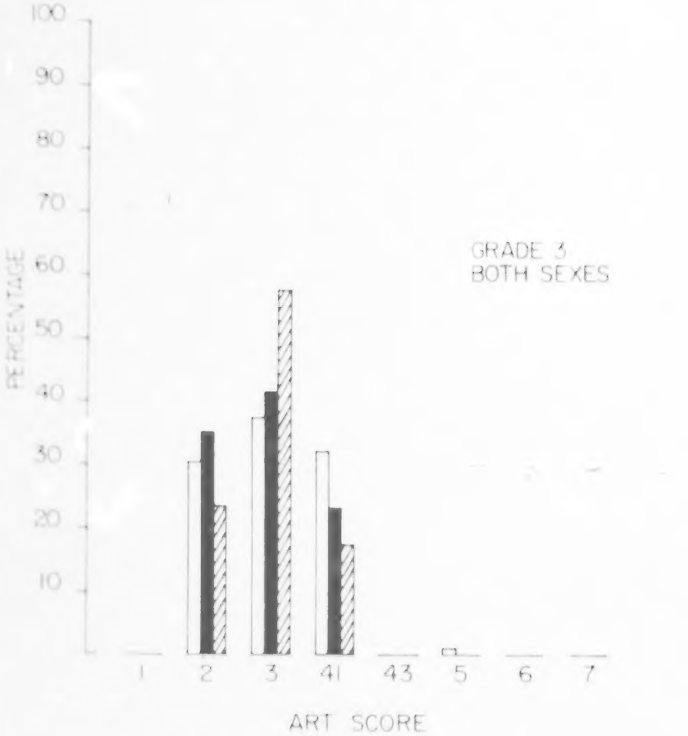

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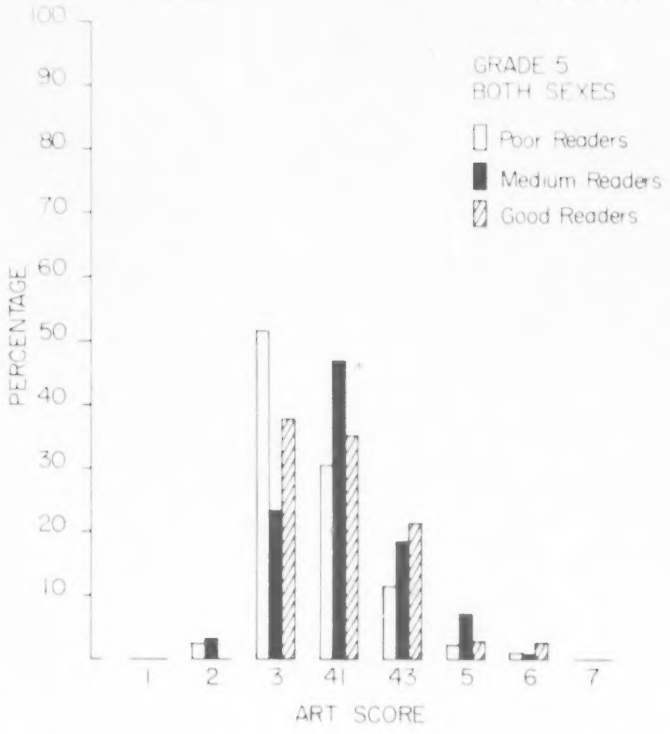

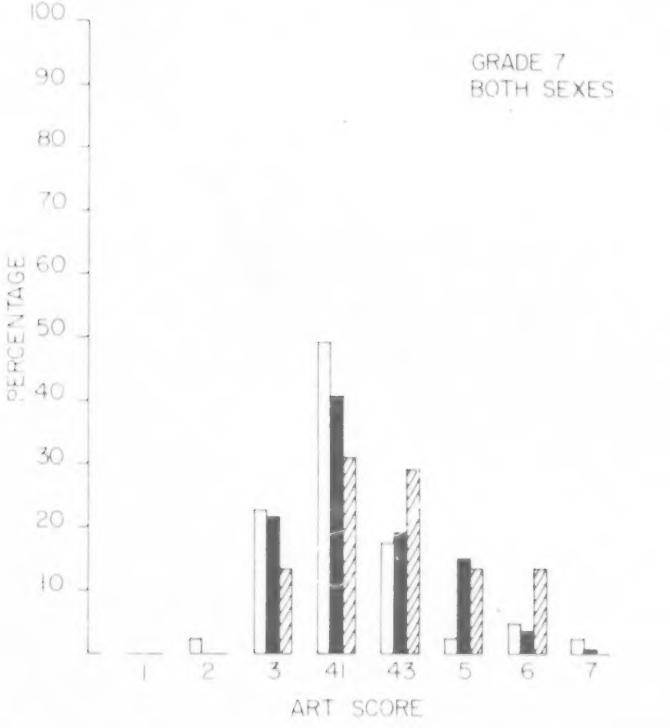

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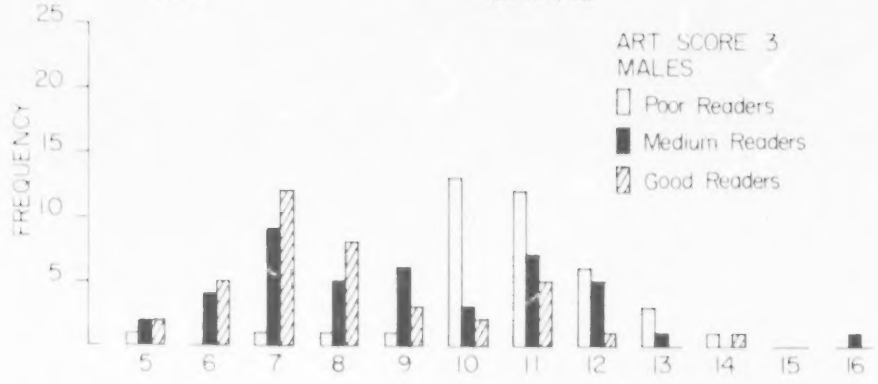

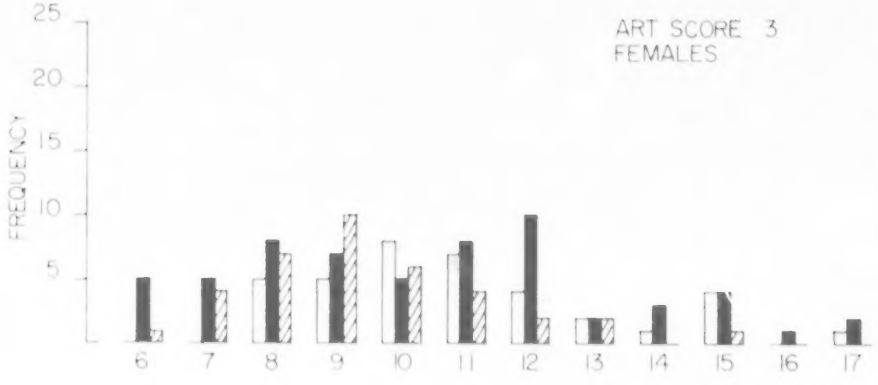

8192

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India, Bombay

	Lower	Middle	
Male	296	206	502
Female	233	180	413
	529	386	915

(I) Age vs. Art Score

1(a) Total population: average age is a roughly increasing function of art score (Dip at 5 based on 39 observations)

1(b) Lower class: same conclusion as 1(a) (Dip at score 5 based on 14 observations)

1(c) Middle class: same as 1(a) (Dips at 5 based on 25 observations and 6 based on 8 observations)

1(d) Males: average age is an increasing function of art score

1(e) Females: same as 1(a) (Dip at 5 based on 6 observations)

(II) Class Differences

For each grade art scores of lower and middle class compared. There is a significant difference between the lower and middle classes for all grades examined. The difference is striking for grades 1, 3 and 5. When the population was further split on sex the only grouping that did not show a significant difference between classes were males in grade 7.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

Both for the 3A and 3J art score groups there were significant differences in the age distributions of the lower and middle class. For the 3A group the lower class was n estimated 4 years older than the middle class and for the 3B group the estimated shift was 2 years.

For males art scores 3A, 43A, 5A, 6A, 3B and 41B showed significant shifts.

For females the 3A group was the only group showing a shift.

0033

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(IV. A/B Style Comparisons

(a) 4IA/B

For the overall population the age distribution of the A group was significantly different from that for the B group. The shift was to the right for the A group (i.e., 4IB types tend to be younger). This is true also of the middle class but not of the lower class.

(b) 4JA/B

No significant differences.

(c) 5A/B

No significant differences.

(V) Reading Score Comparisons

Do better readers have higher scores (grade by grade comparison)?

Overall population: in grades 5 and 7 the results are significant.

Split on sex: for grade 5 results for both sexes are significant. For grade 7 only males give significant results.

Do better readers reach their levels earlier?

Overall population: for scores 2 and 3, yes, results are significant.

Split on sex: for females scores 2 and 3 show significant results. For males score 3 shows significant results.

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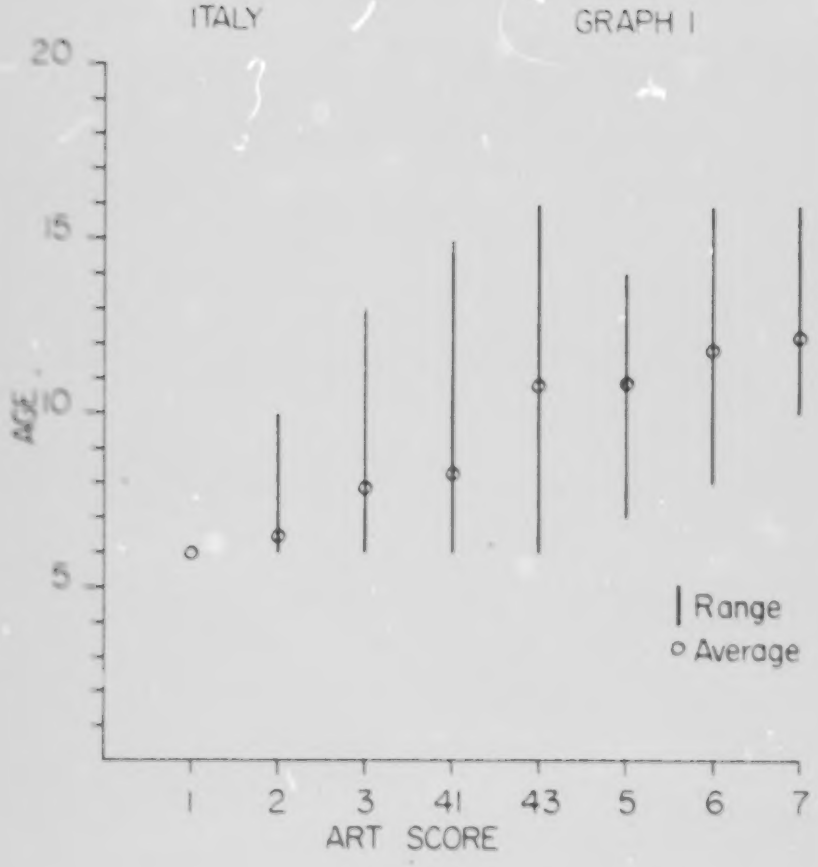

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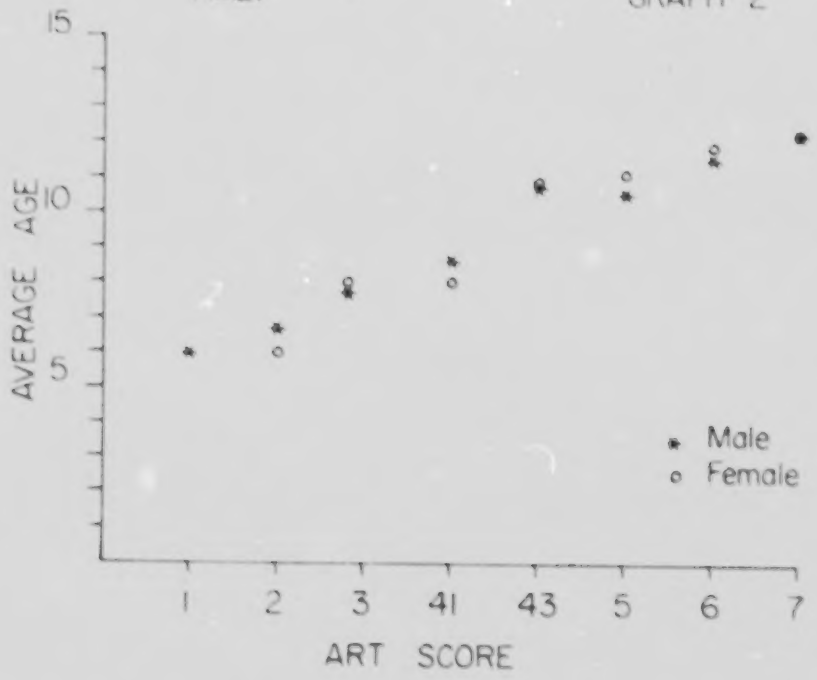

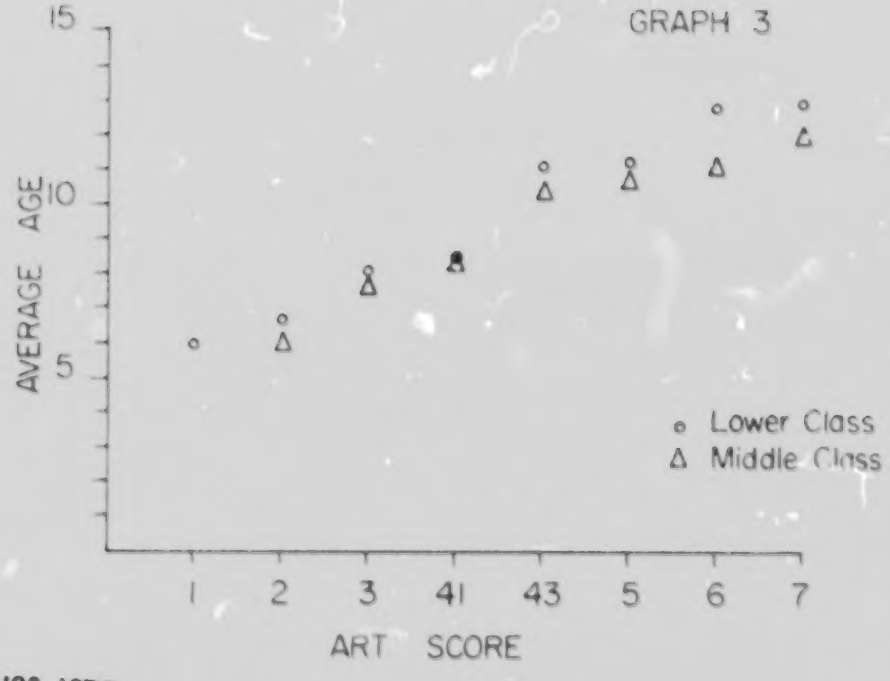

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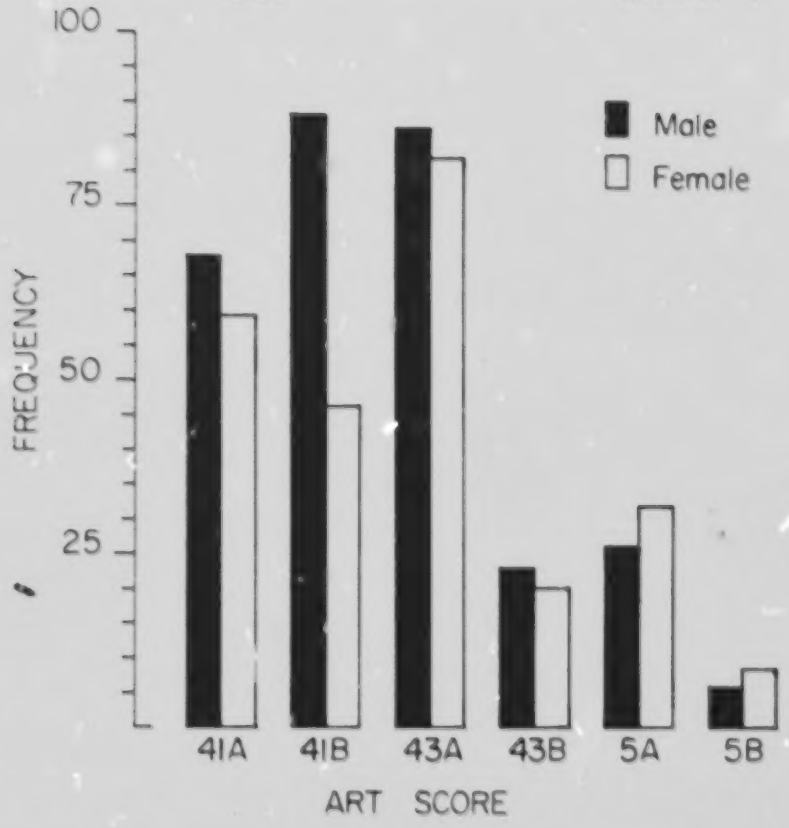
ITALY

GRAPH 4



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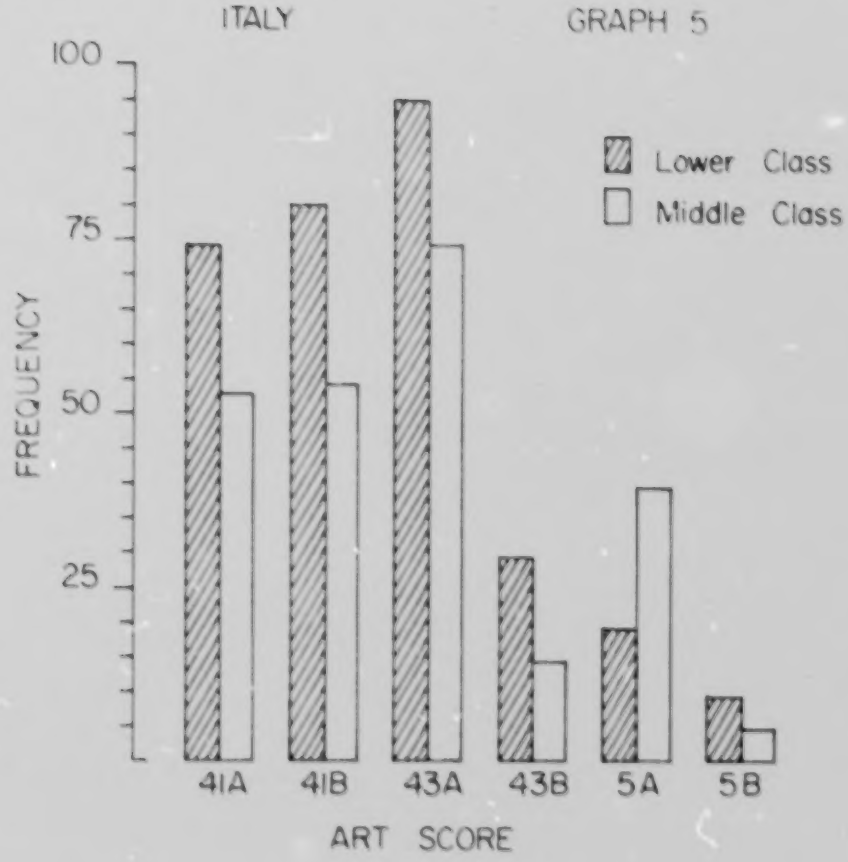

0138

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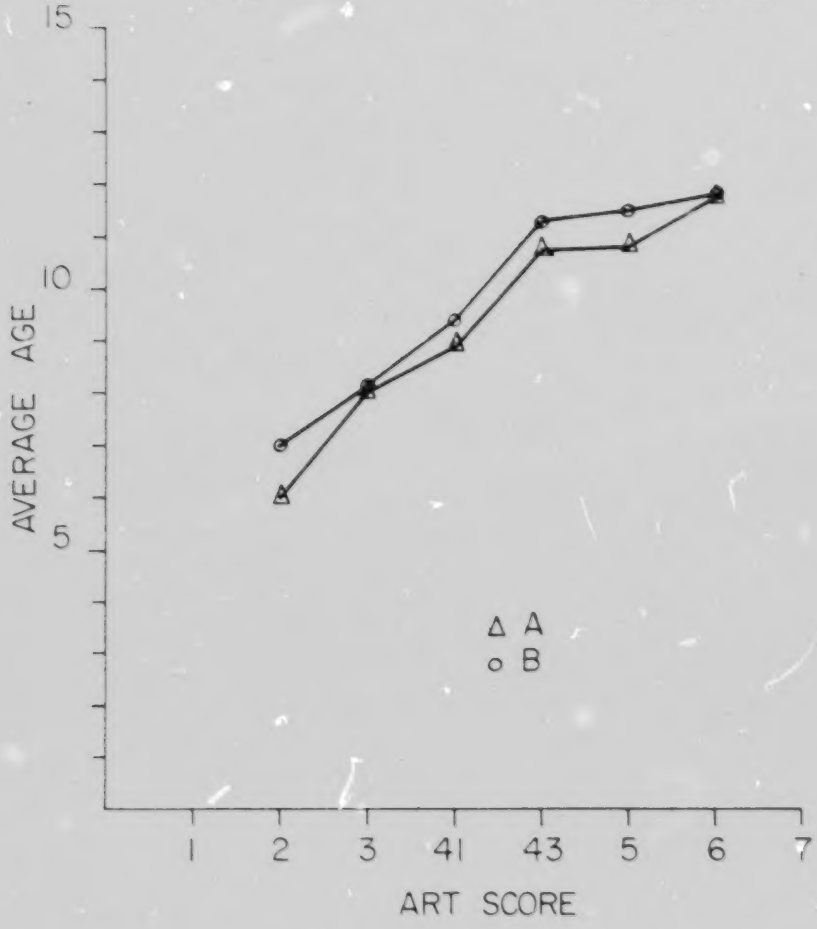

00199

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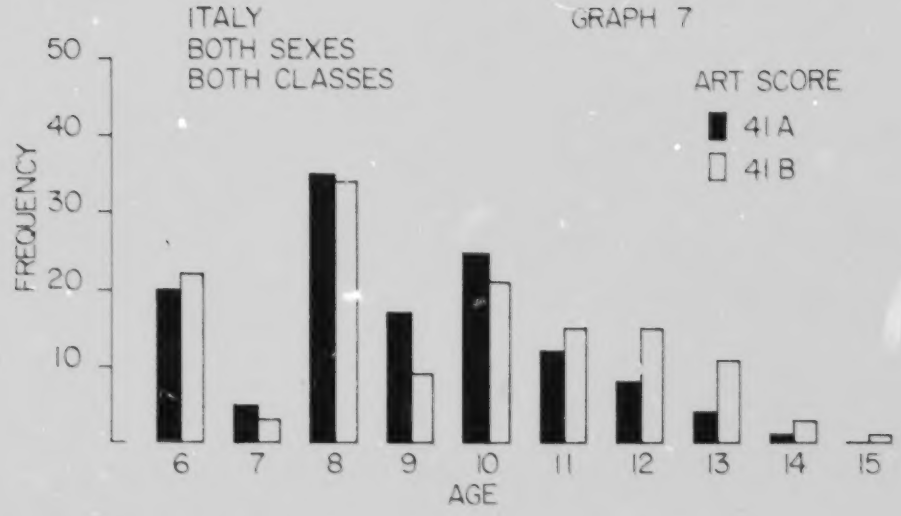

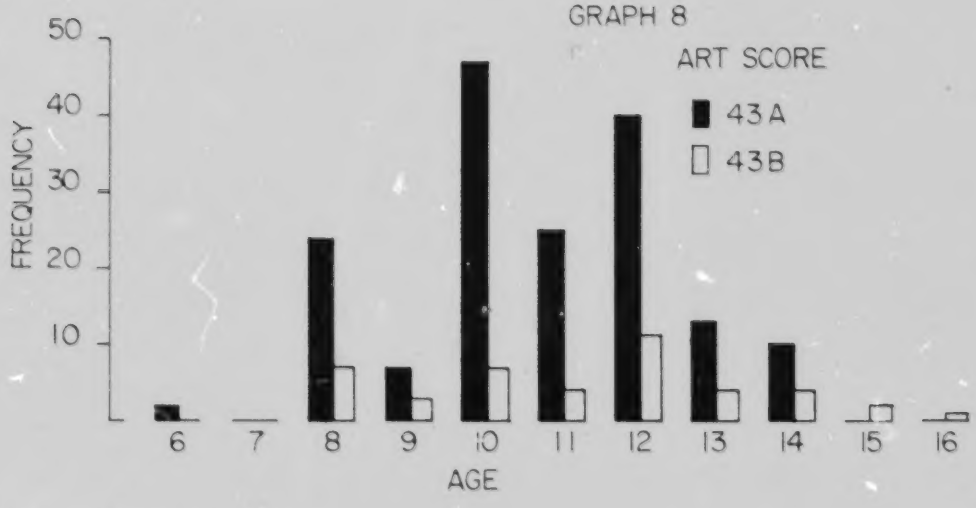

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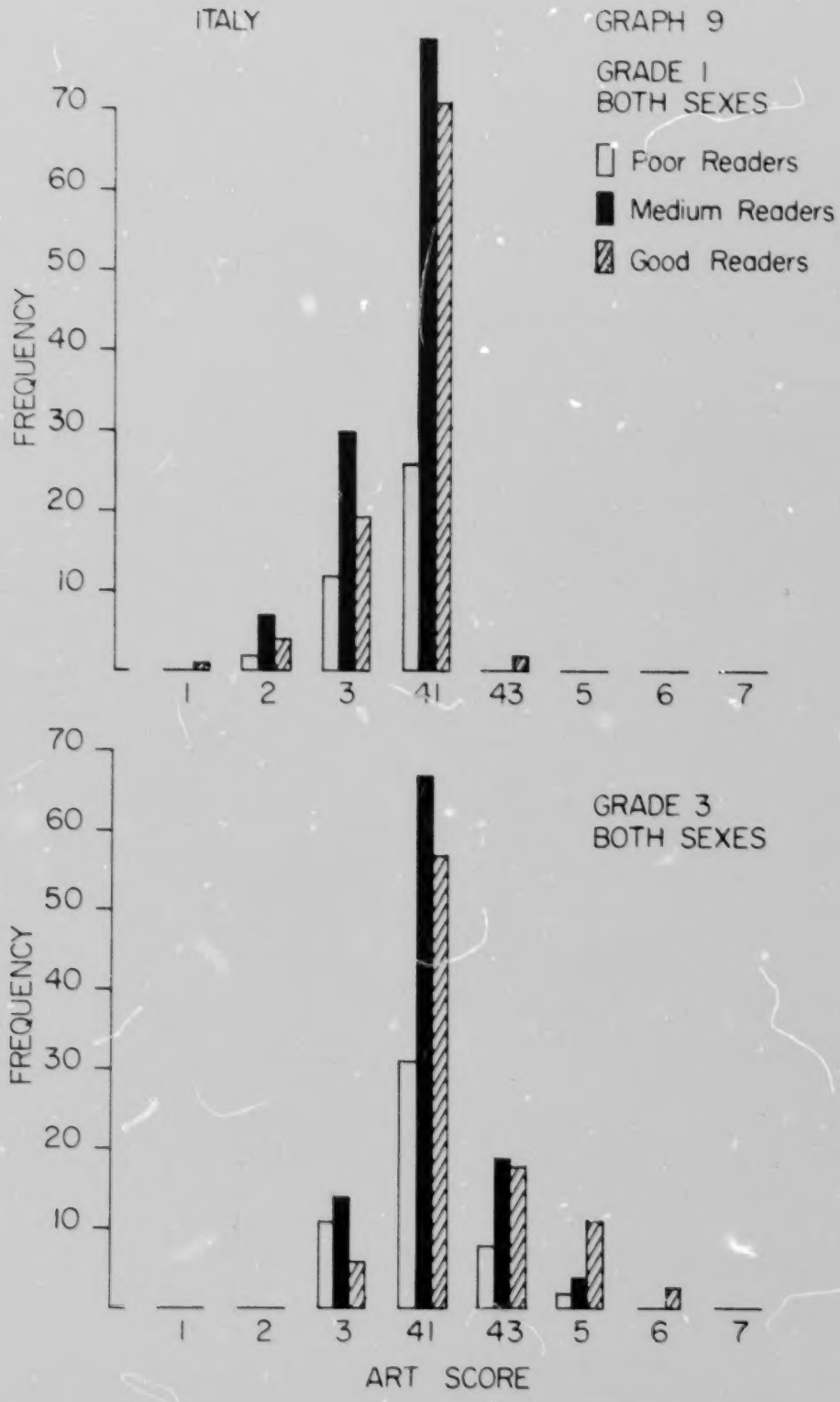

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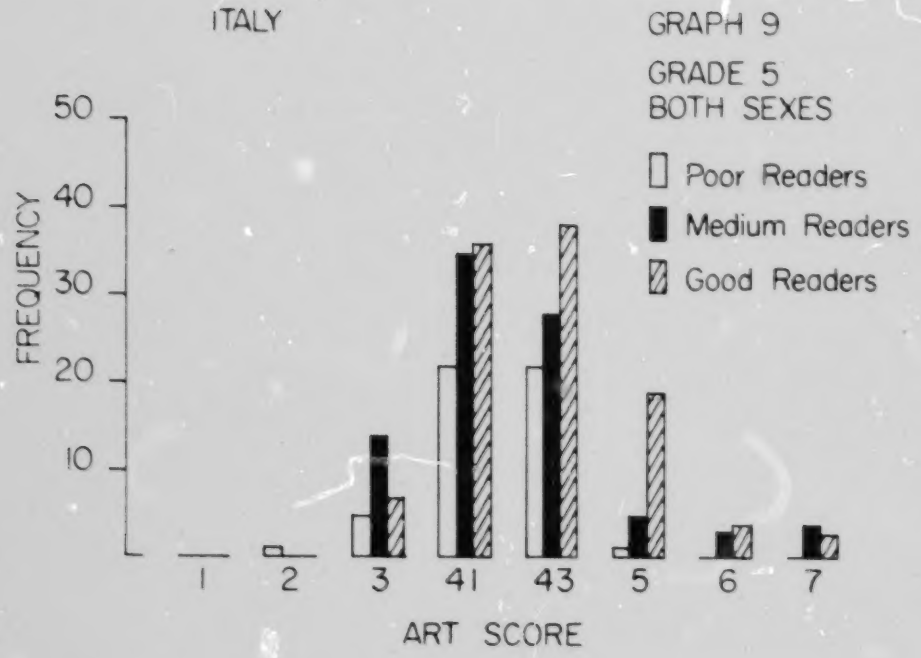

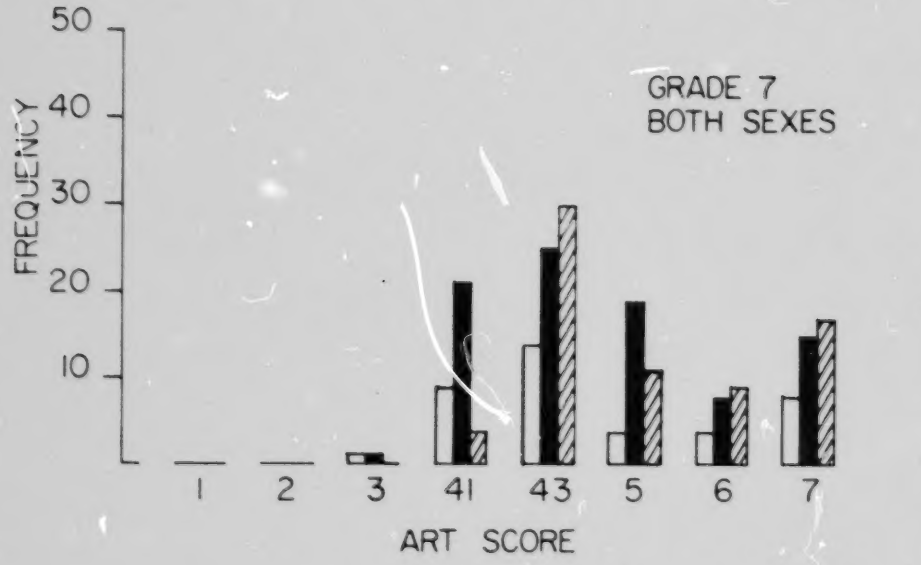

00202

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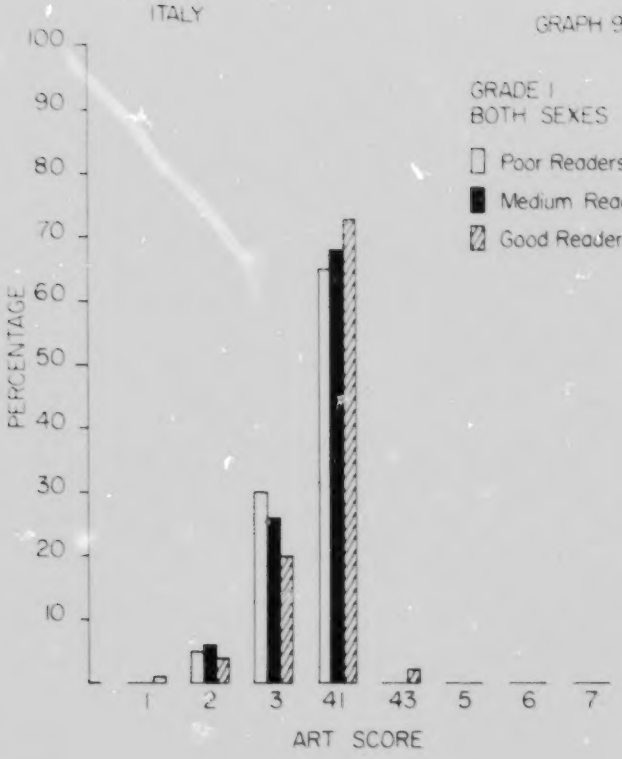
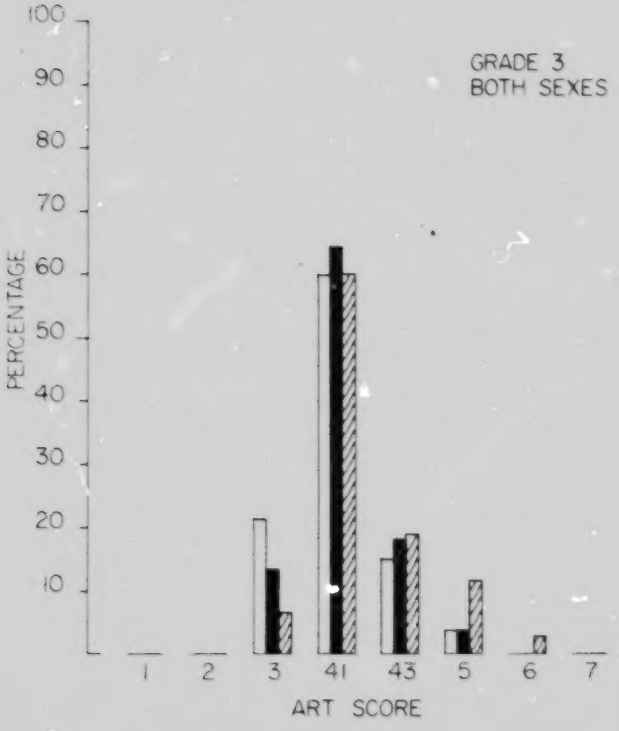
ITALY

GRAPH 9a





0203

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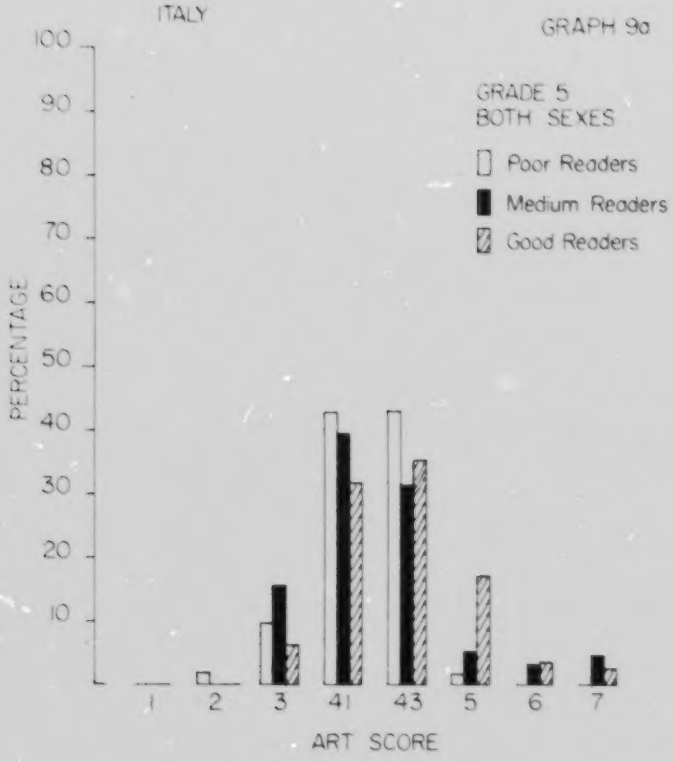
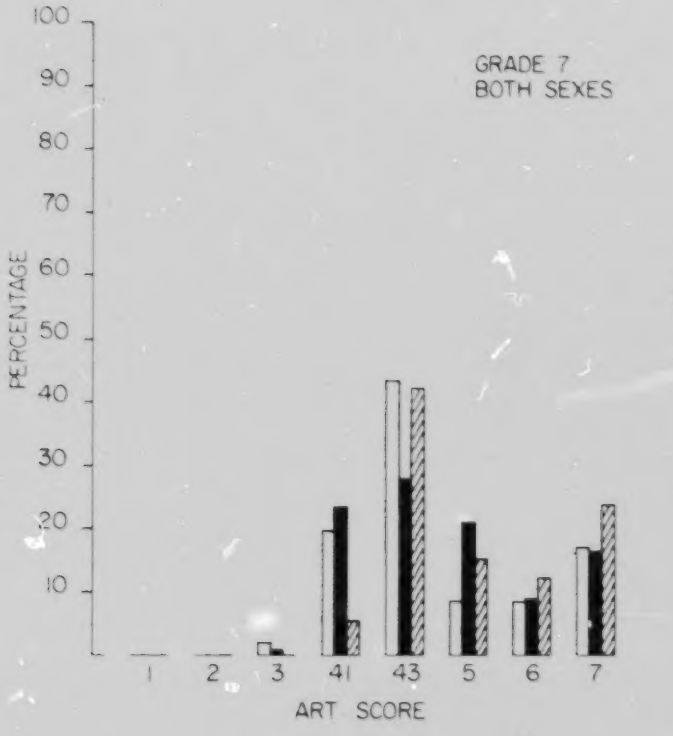
ITALY

GRAPH 9a





00201

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Italy, Milan

	Lower	Middle	
Male	262	216	478
Female	286	203	489
	548	419	967

(I) Age vs. Art Score

1(a) Total population: average age increases with art score

1(b) Lower class: average age increases with art score

1(c) Middle class: average age increases with art score

1(d) Males: sequence is approximately increasing (Dip at 5 based on 34 observations)

1(e) Females: sequence is approximately increasing (Note: dip at 41 based on 239 observations)

(II) Class Differences

Total population: there was a significant difference (middle class children tending to have higher art scores) for grades 5 and 7.

Females: the differences were significant in grades 3, 5 and 7 only.

Males: no significant results for any of the grades.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

Total population: middle class significantly younger for those in 43A and 43B (estimated shifts 1 year) and 6A (shift 2 years).

For females alone: middle class significantly younger in 41A, 41B, 43A and 43B.

For males alone: only significant result is for those in 6A (middle class younger by estimated 3 years).

(IV) A/B Style Comparisons

Only significant result is for lower class females for the case 41A vs. 41B where the B group tends to be older than the A group by an estimated 1 year.

(V) Reading Score Comparisons

Do better readers have higher scores?

Total population: yes, in grades 3, 5 and 7.

Females alone: yes, in grades 3 and 5.

Males alone: yes, for grades 3 and 7.

Are better readers younger when compared with others with the same art score? Yes, significantly so for the following cases:

Total population: for art scores 41, 43 and 5.

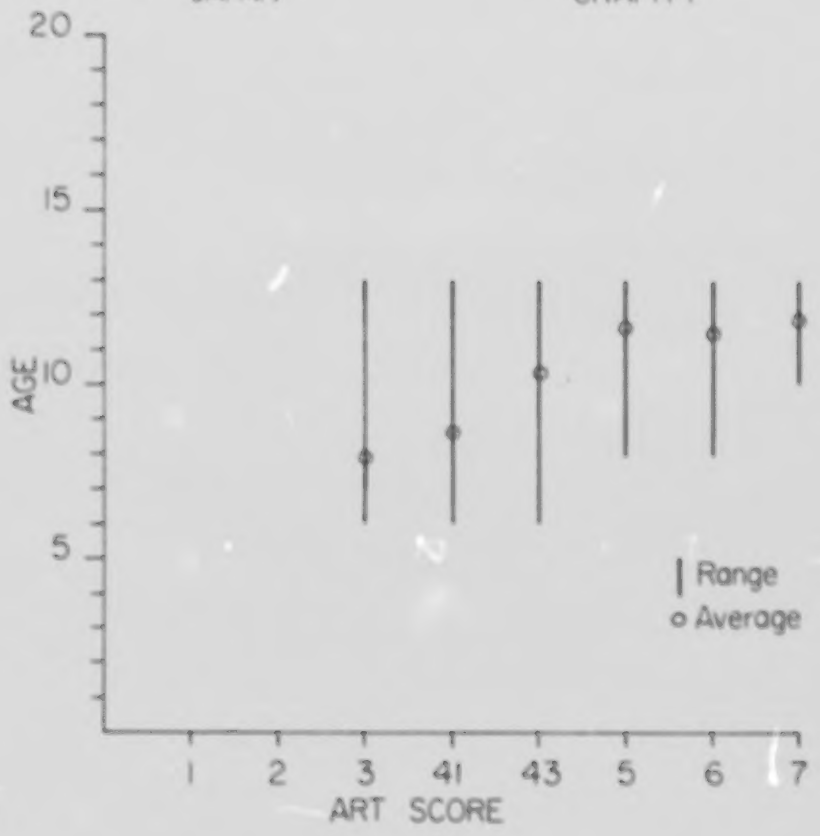
Females alone: for art scores 41, 43 and 5.

Males alone: for art scores 41, 43 and 5.

01206

JAPAN

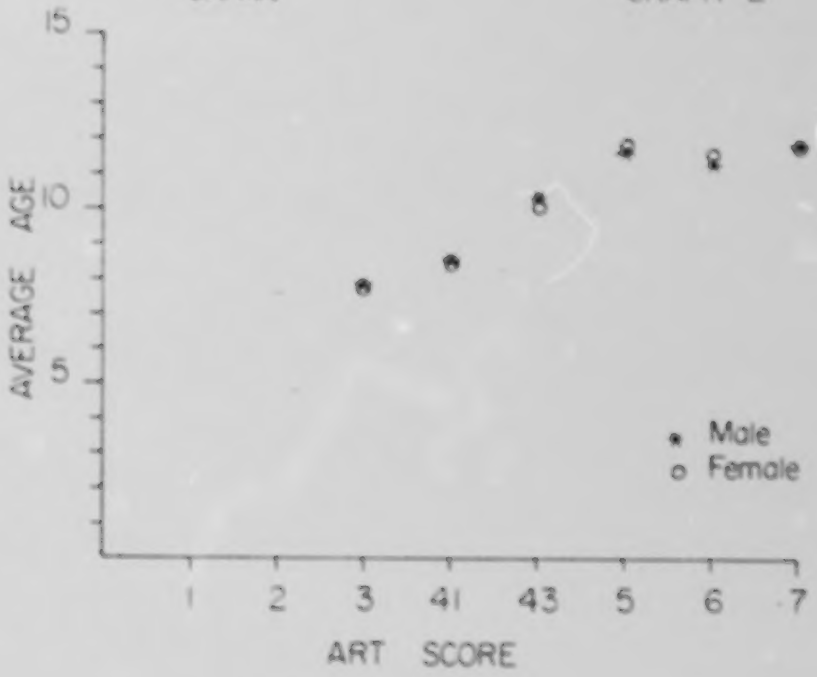
GRAPH I



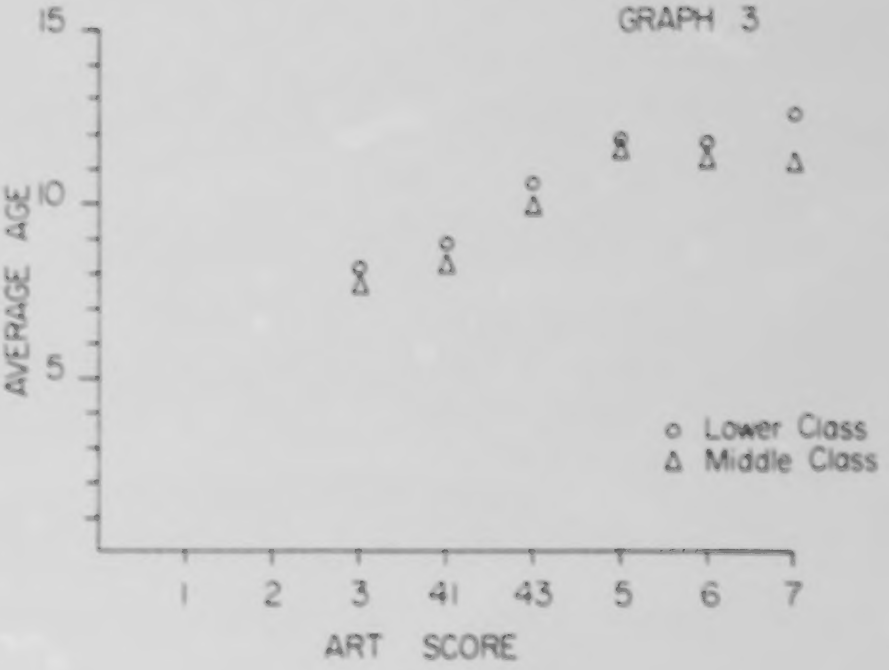
0207

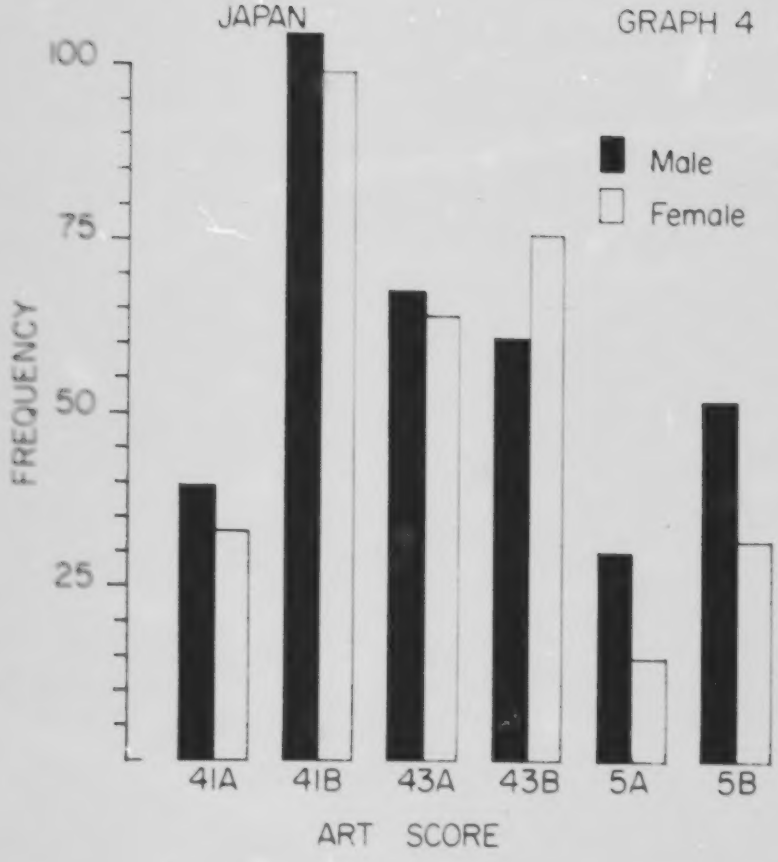
JAPAN

GRAPH 2



GRAPH 3

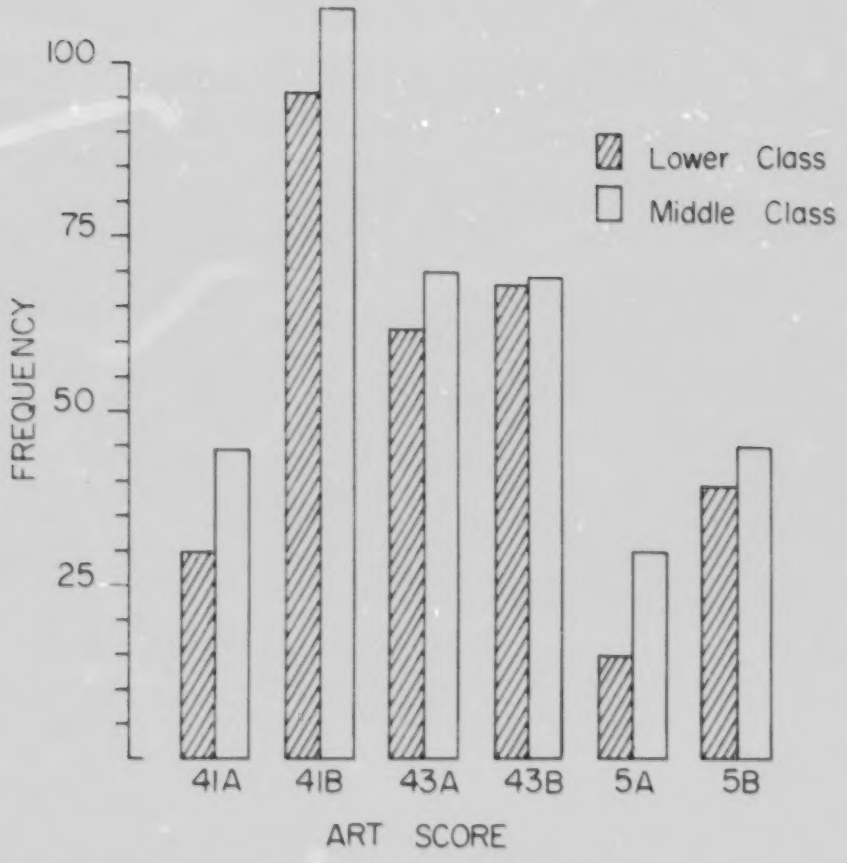



JAPAN
GRAPH 4
100
75
50
25
FREQUENCY
Male
Female
41A
41B
43A
43B
5A
5B
ART SCORE

09209

JAPAN

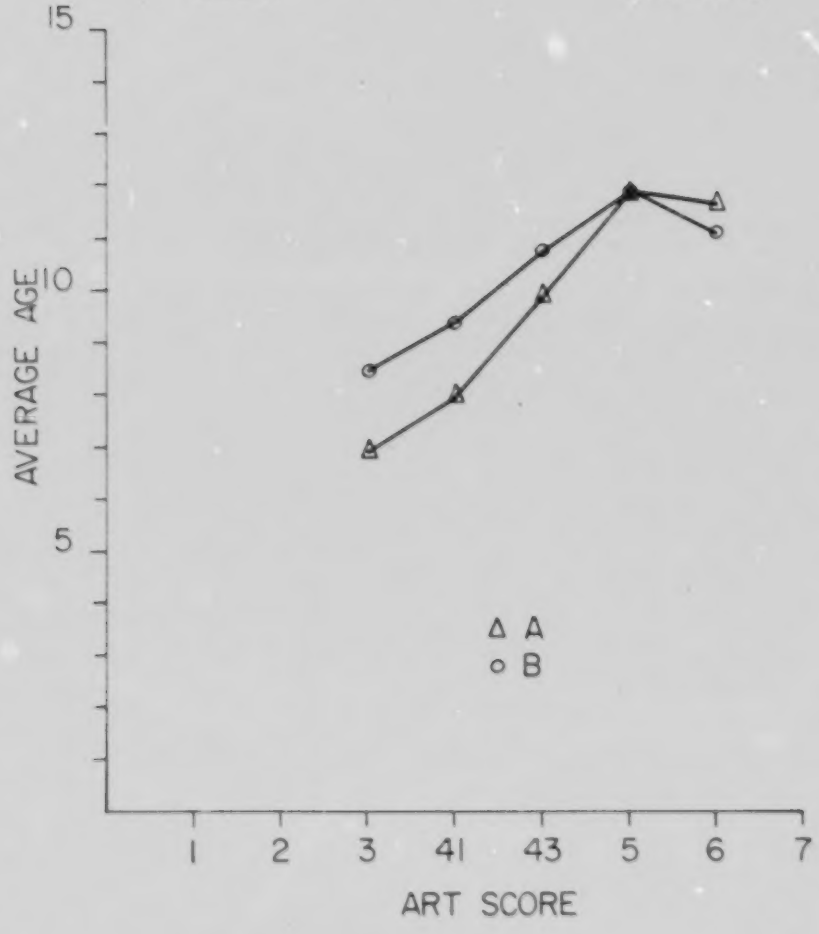
GRAPH 5



00210

JAPAN

GRAPH 6



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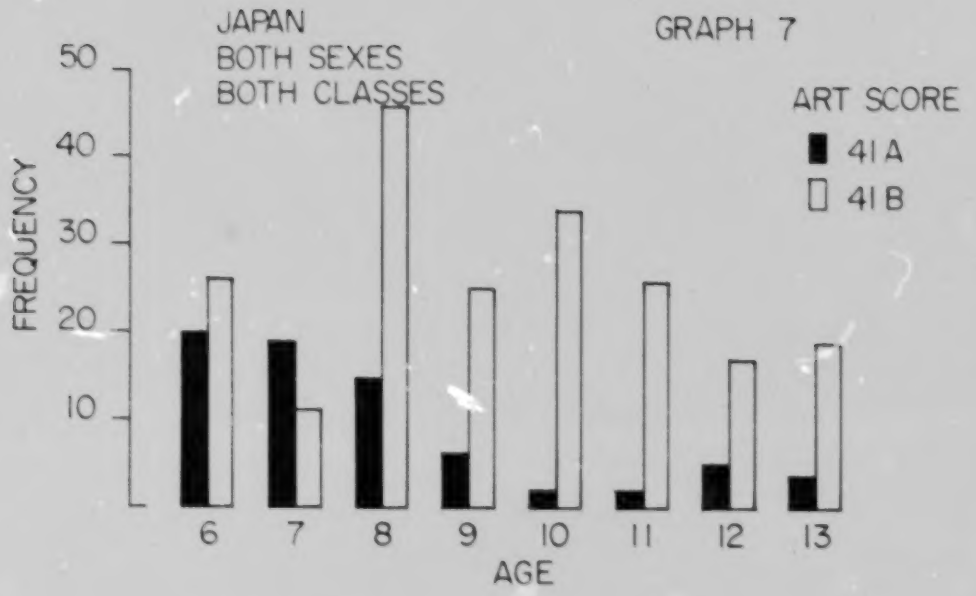
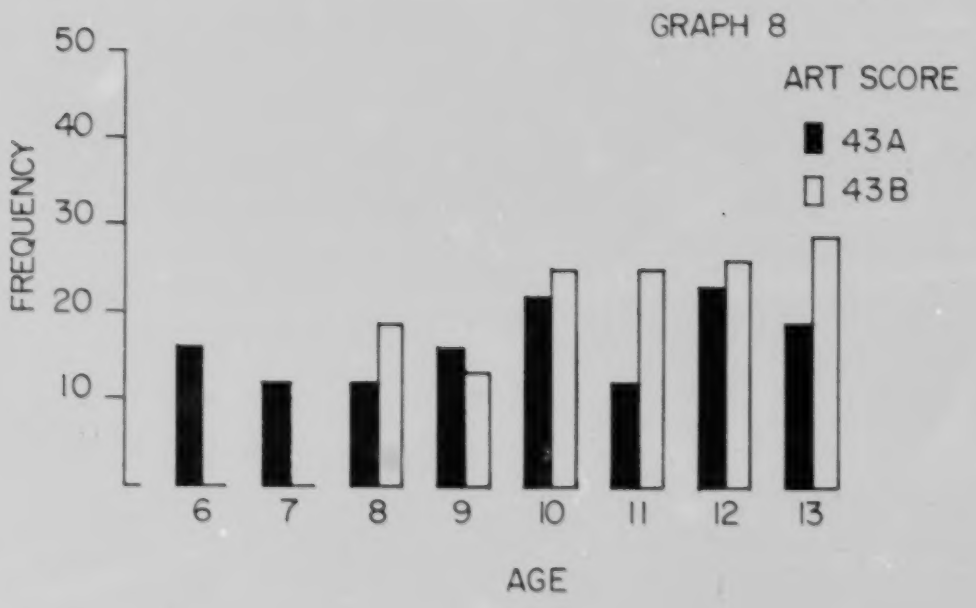

JAPAN
BOTH SEXES
BOTH CLASSES
GRAPH 7
ART SCORE
41A
41B
FREQUENCY
50
40
30
20
10
6
7
8
9
10
11
12
13
AGE


GRAPH 8
ART SCORE
43A
43B
FREQUENCY
50
40
30
20
10
6
7
8
9
10
11
12
13
AGE

Japan, Tokyo

	Lower	Middle	
Male	223	314	537
Female	225	217	442
	448	531	979

(I) Age vs. Art Score

1(a) Total population: average age is an almost increasing function of art score (Dip at 6 based on 25 observations)

1(b) Lower class: same as 1(a) (Dip at 6 based on 8 observations)

1(c) Middle class: increasing except for dips at 6 (based on 17 observations) and 7 (based on 13 observations)

1(d) Males: same as 1(a) (Dip at 6 based on 15 observations)

1(e) Females: same as 1(a) (Dips at 6 based on 10 observations and 7 based on 6 observations)

(II) Class Differences

When compared for each grade by art score there is no significant difference between lower and middle class.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

The middle class was found to be significantly younger than the lower class in the following cases:

Both sexes combined: 41B (shift 1 year)
43A (shift 1 year)
5A and 5B (shift in each case 1 year)
6B (shift 2 years)

Males alone: 41B (shift 2 years)
5B (shift 1 year)

Females alone: 3A (shift 3 years)
41A and 41B (shift in each case 1 year)
43A and 43B (shift in each case 1 year)
5A (shift 1 year)
6B (shift 2 years)

00213

(IV) A/B Style Comparisons

Do B types tend to be significantly older than A types? Yes, in the following cases:

(a) 41A/B

Total population (estimated shift 2 years)

Lower class (estimated shift 2 years)

Middle class (estimated shift 1 year)

Males (estimated shift 2 years)

Females (estimated shift 2 years)

(b) 43A/B

Total population (estimated shift 1 year)

Lower class (estimated shift is 0)

Middle class (estimated shift 1 year)

Males (estimated shift 1 year)

Females (estimated shift 1 year)

(c) 5A/B

No significant results.

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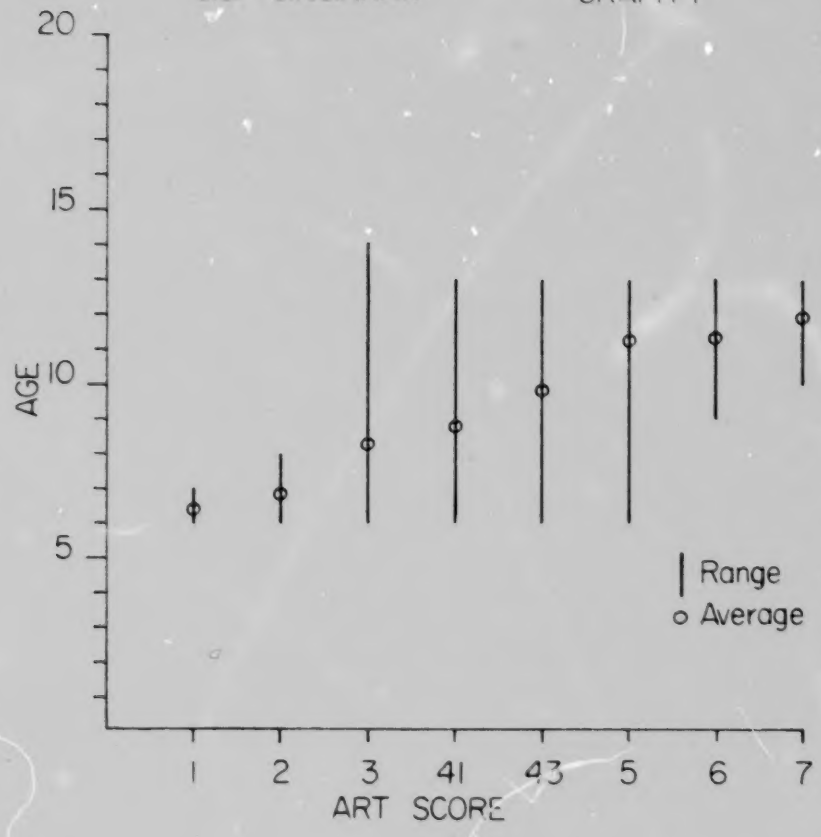

00215

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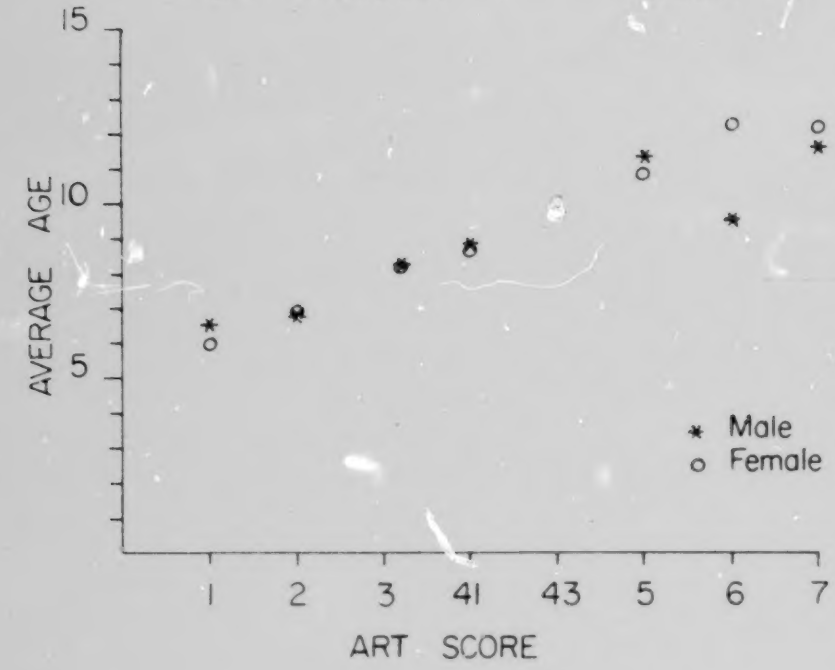

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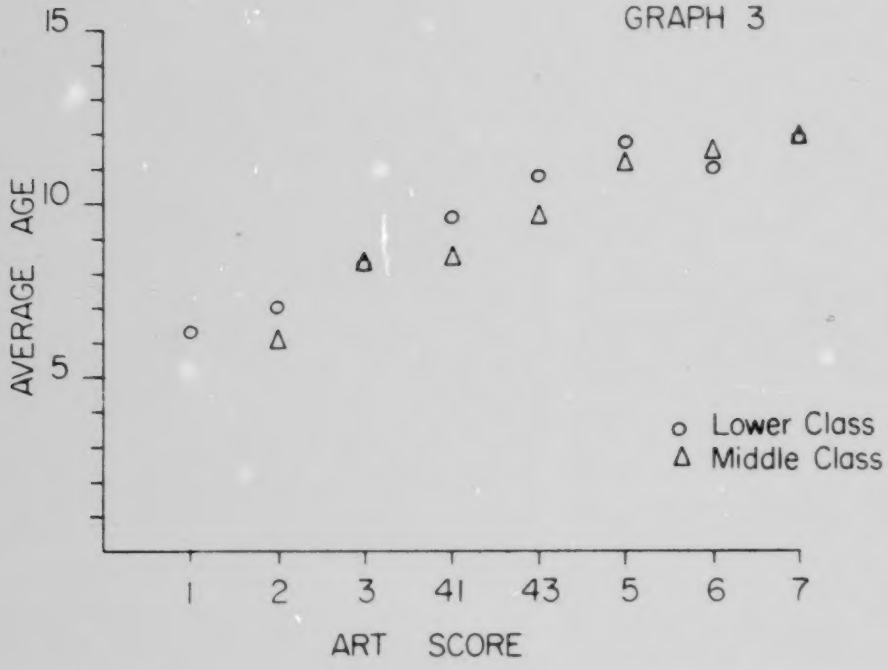

00216

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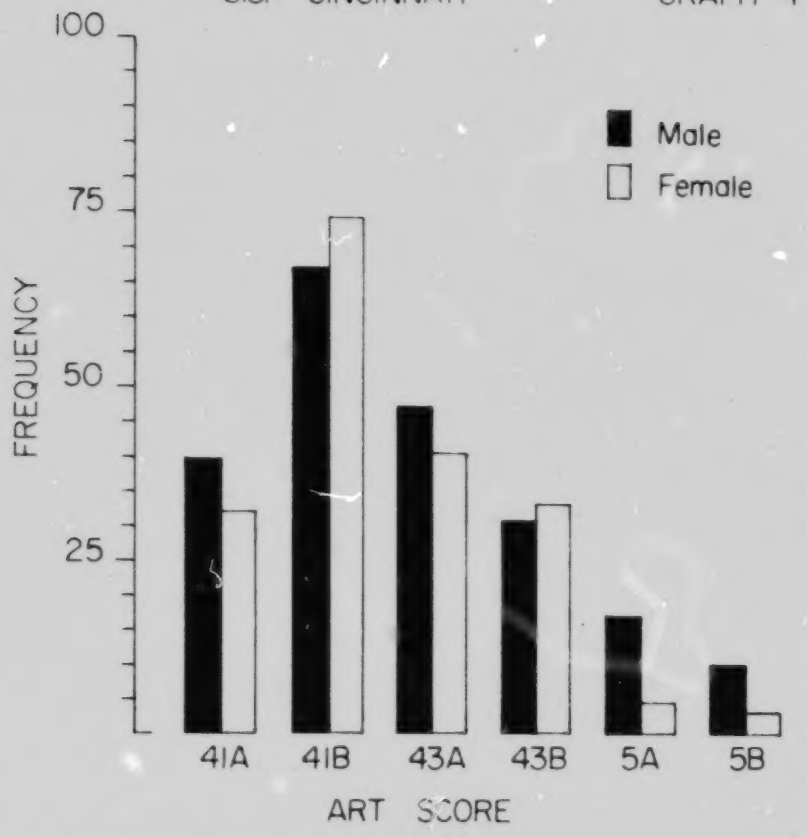

00217

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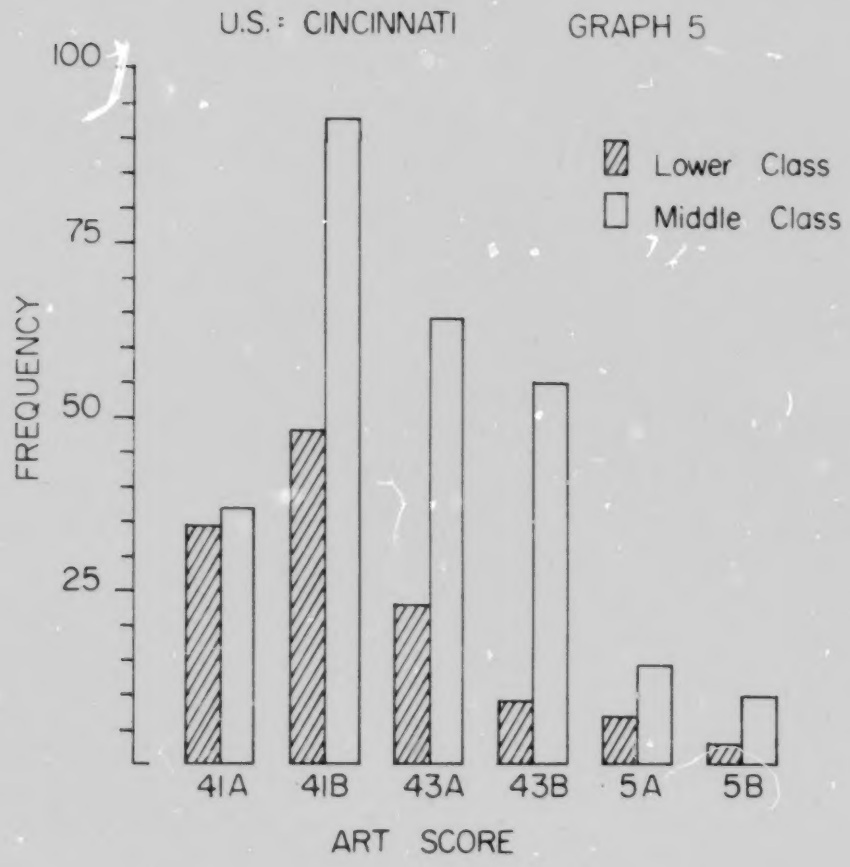
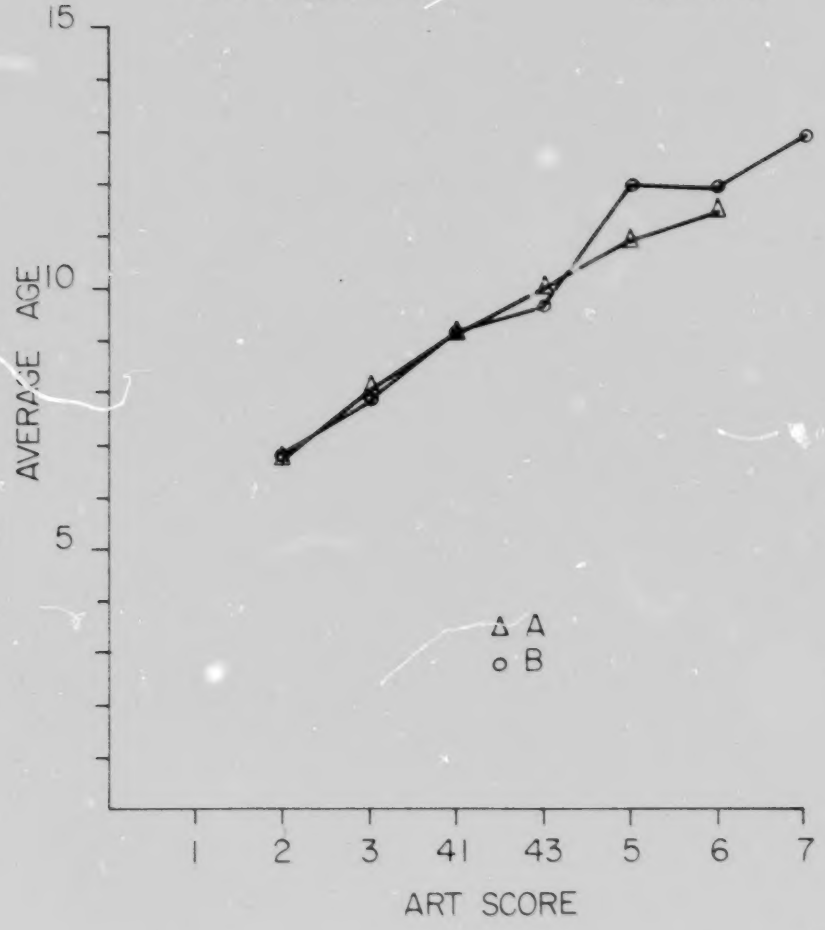


0219

U.S. CINCINNATI GRAPH 6



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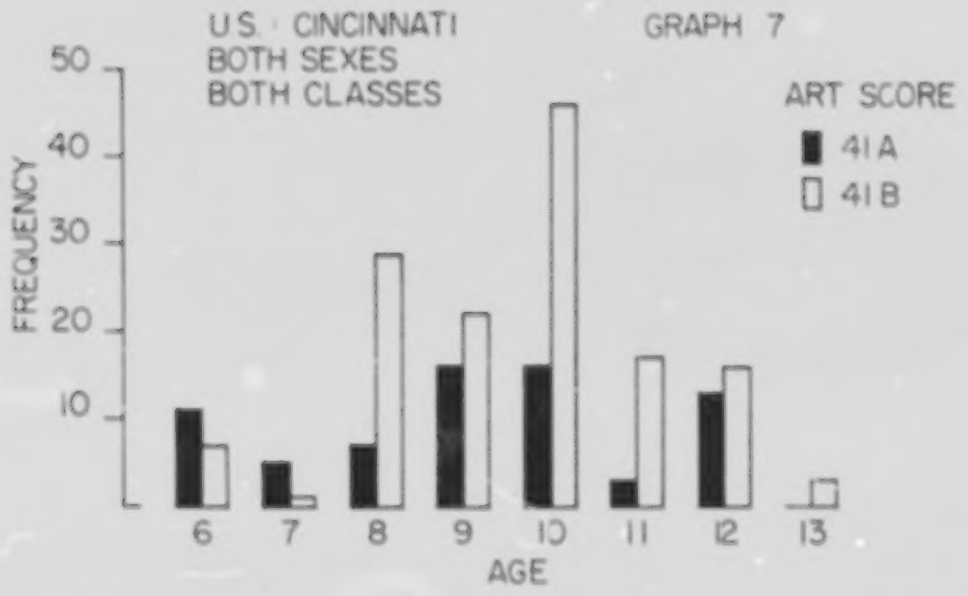
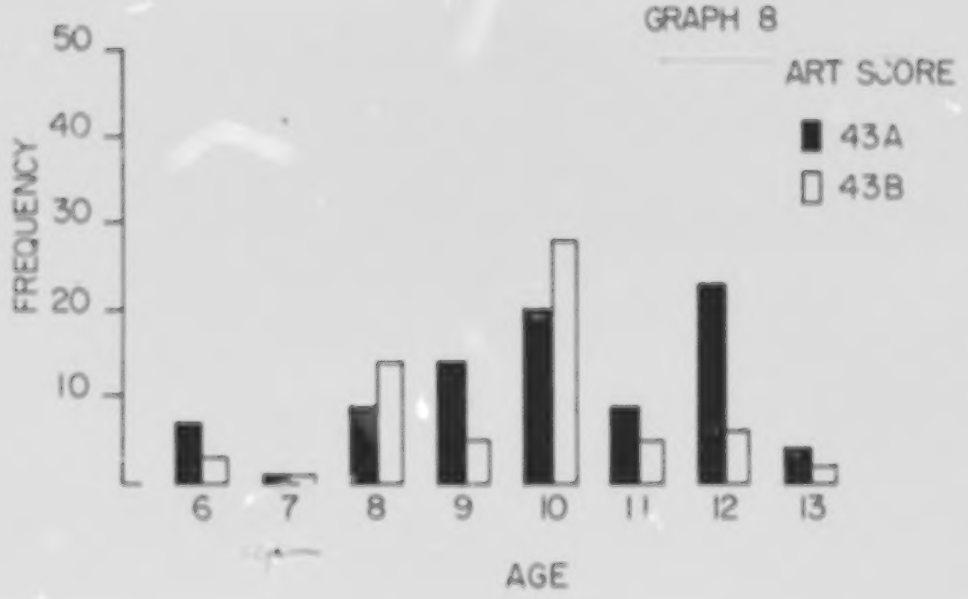
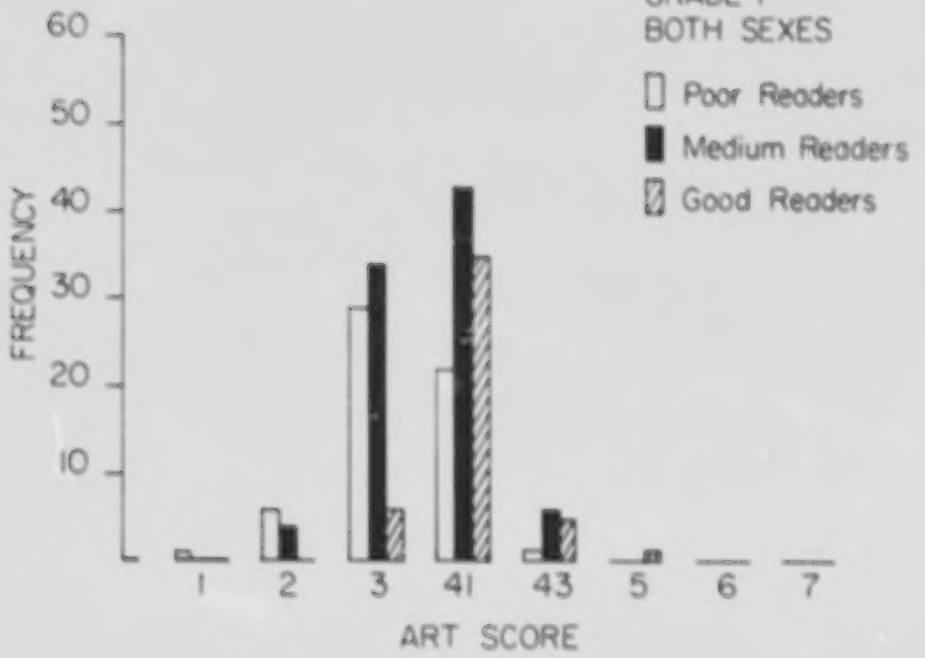
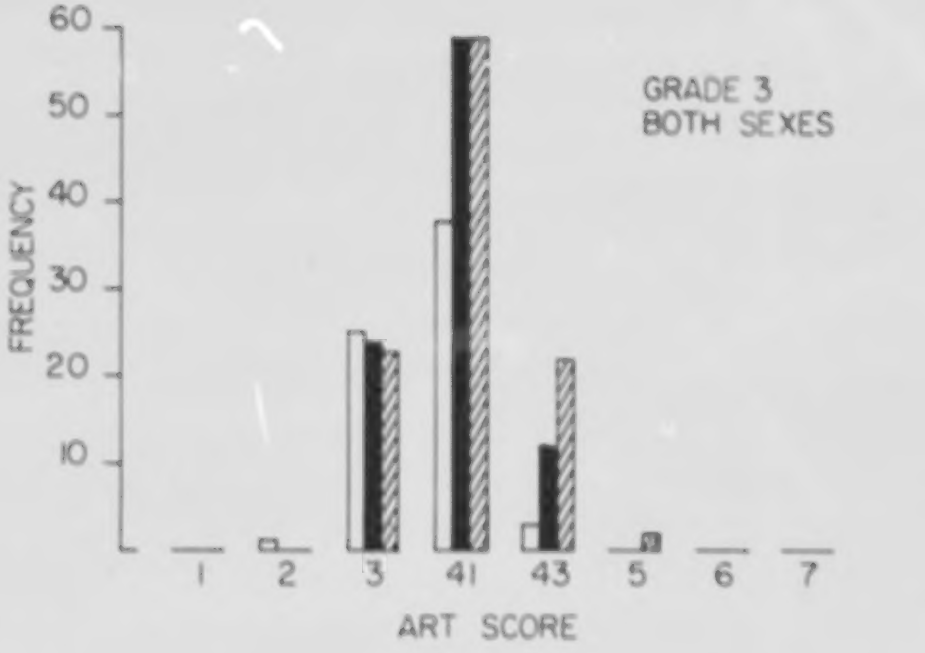

U.S. CINCINNATI
BOTH SEXES
BOTH CLASSES
GRAPH 7
ART SCORE
41A
41B
FREQUENCY
50
40
30
20
10
6
7
8
9
10
11
12
13
AGE


GRAPH 8
ART SCORE
43A
43B
FREQUENCY
50
40
30
20
10
6
7
8
9
10
11
12
13
AGE

U.S. : CINCINNATI

GRAPH 9





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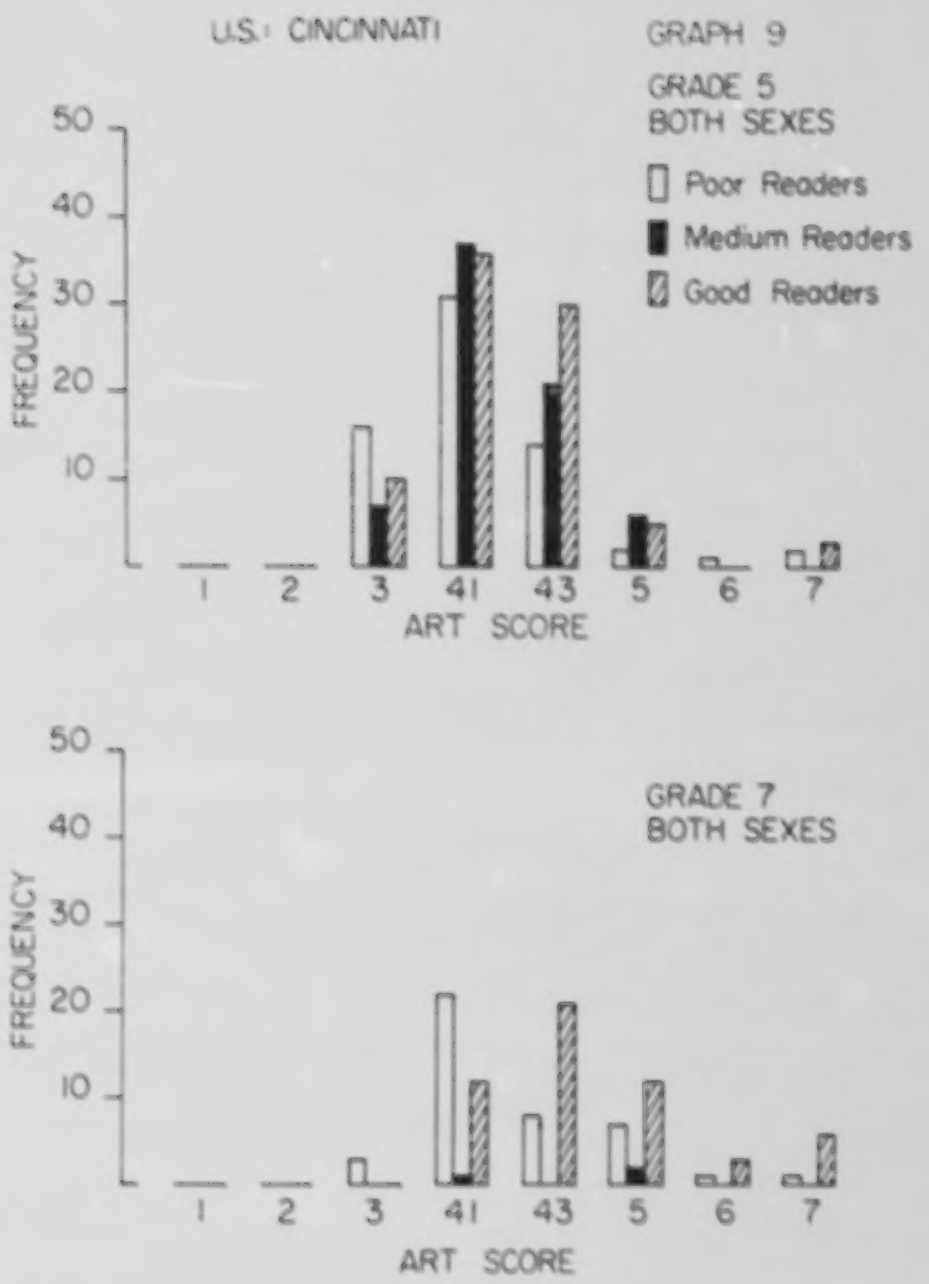
U.S.: CINCINNATI
GRAPH 9
GRADE 5
BOTH SEXES
Poor Readers
Medium Readers
Good Readers
FREQUENCY
50
40
30
20
10
1
2
3
41
43
5
6
7
ART SCORE
GRADE 7
BOTH SEXES
FREQUENCY
50
40
30
20
10
1
2
3
41
43
5
6
7
ART SCORE

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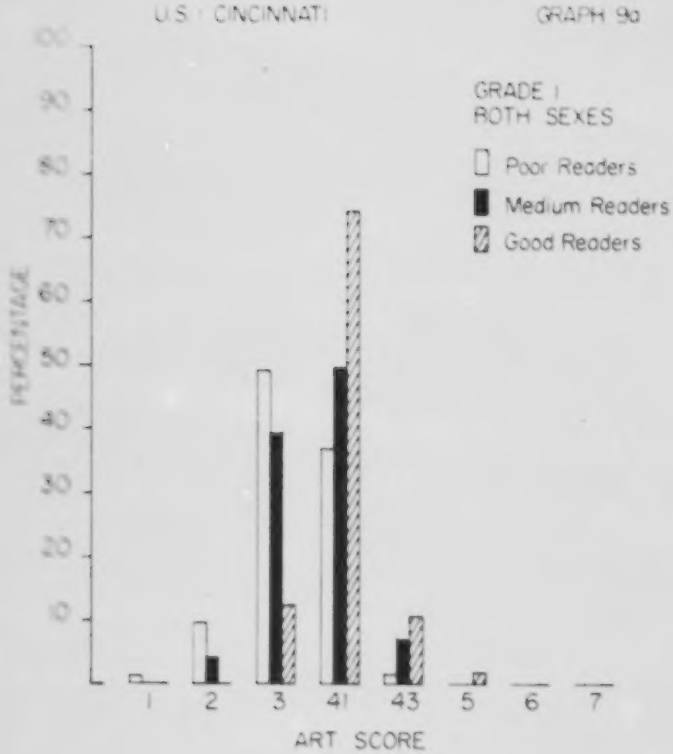
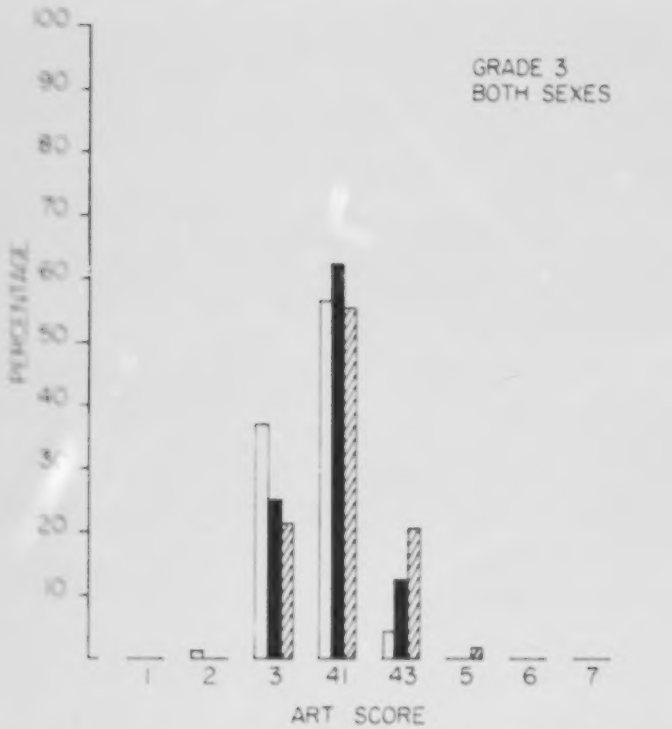
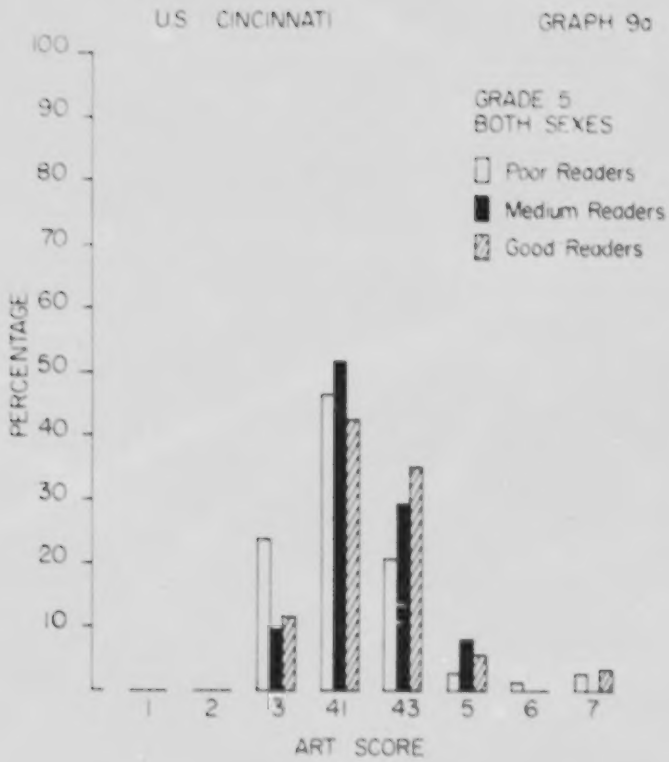
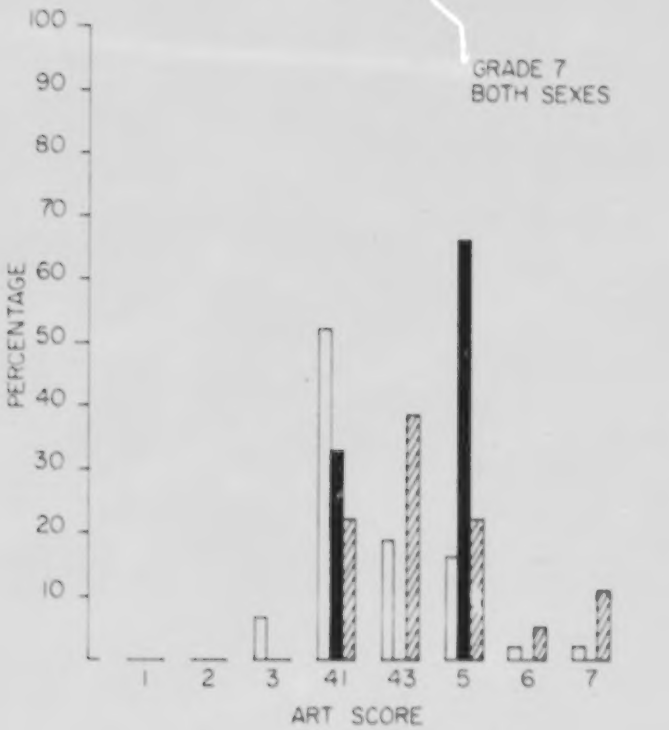
U.S. - CINCINNATI GRAPH 9a





00223


U.S. CINCINNATI
GRAPH 9a
GRADE 5
BOTH SEXES
Poor Readers
Medium Readers
Good Readers
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
1
2
3
41
43
5
6
7
ART SCORE


GRADE 7
BOTH SEXES
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
1
2
3
41
43
5
6
7
ART SCORE

00224

U. S. A., Cincinnati, Ohio

	Lower	Middle	
Male	200	233	433
Female	168	226	394
	368	459	827

(I) Age vs. Art Score

1(a) Total population: average age increases with art score

1(b) Lower class: average age approximately increasing with art score (Dip at 6 based on only 2 observations)

1(c) Middle class: same as 1(a)

1(d) Males: same as 1(b) (Dip at 6 based on only 2 observations)

1(e) Females: approximately increasing (Dip at 7 based on 6 observations)

(II) Class Differences

For each grade the art scores of lower and middle class were examined. For grades 1, 3, 5 and 7, i.e., all grades (grades 0 and 4 have no observations in the middle and lower classes respectively) where testing was possible the differences were very significant. Middle class children do consistenlty better. When split on sex this feature continues to be true.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

There was a significant shift in the age distribution of the middle class (to the left, i.e., they were younger) when compared to the lower class for the following cases:

Both sexes combined: 41A (shift 1 year), 41B (shift 1 year)
43A (shift 1 year), 43B (shift 2 years)

Males: 41A, 41B (shifts of 2 years)
43A (shift of 1 year), 43B (shift of 2 years)

Females: 41A (shift 3 years), 41B (shift 1 year)

00225

(IV) A/B Style Comparisons

For the middle class there was a significant shift, B types being older than A types for the following cases:

(a) 41A/B: middle class males, females and all middle class

(b) 43A/B

There was a shift to the left (i.e., B's younger) for the whole population and also for all males and all middle class males.

(c) 5A/B

5B's were significantly older for the total population, middle class males, all males and all middle class.

(V) Reading Score Comparisons

Do better readers have higher art scores? Yes, significantly, for the following cases:

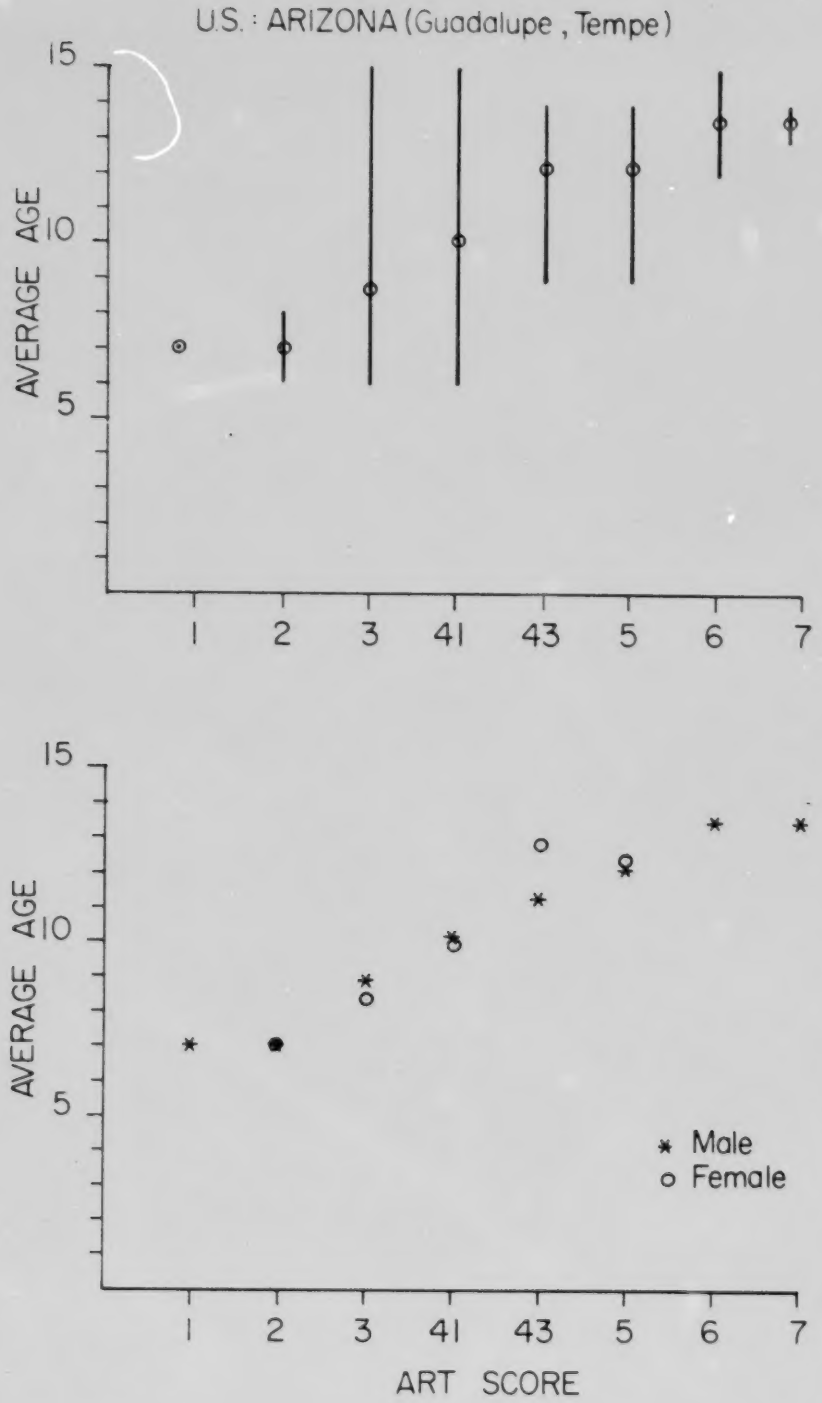
Total population: grades 1, 3, 5 and 7

Males: significant results for grades 1, 3, 5 and 7

Females: significant results for grades 1, 3 and 7.

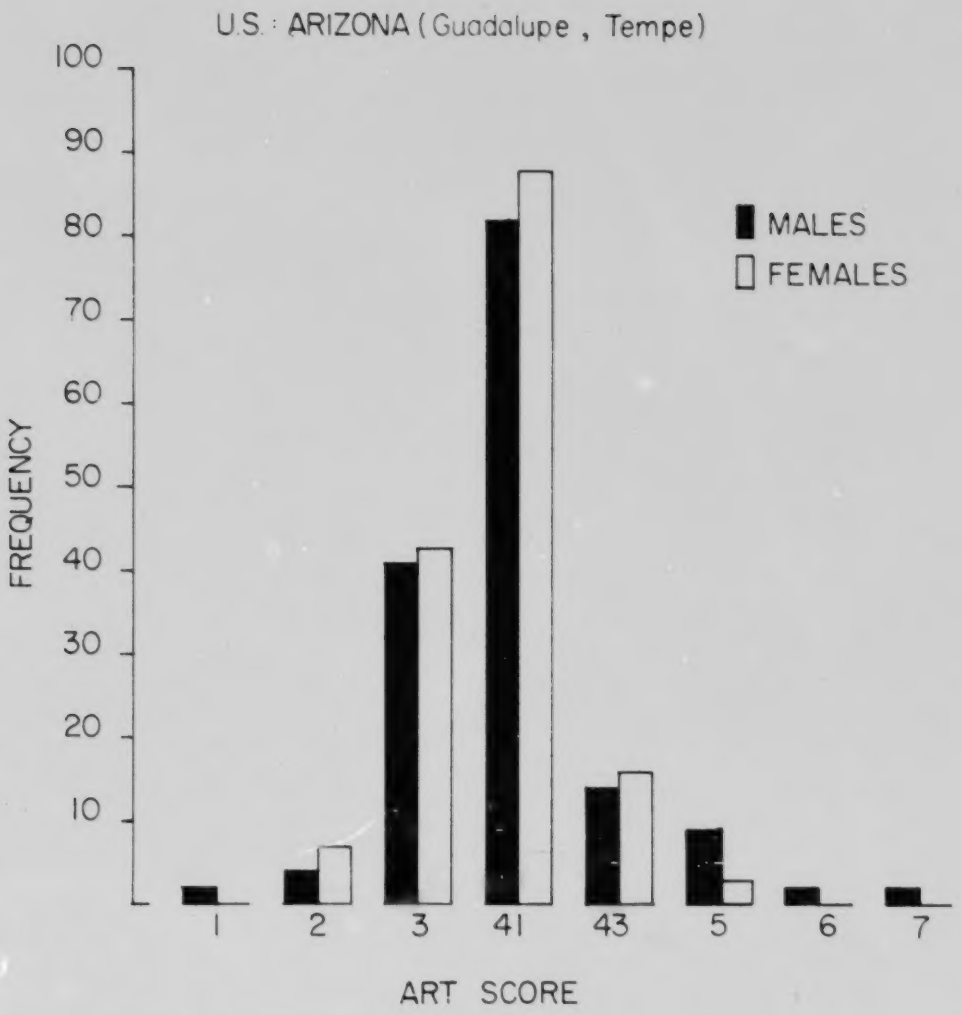
Do better readers tend to reach their respective art score level sooner, i.e., are they younger? Yes, for those with art score 41 and males with art score 43. The estimated difference in ages between poor and medium readers with art score 41 is 1 year.

00226


U.S. : ARIZONA (Guadalupe , Tempe)
AVERAGE AGE
15
10
5
1
2
3
41
43
5
6
7
AVERAGE AGE
15
10
5
* Male
o Female
1
2
3
41
43
5
6
7
ART SCORE

00227

BEST COPY AVAILABLE



30228

U. S. A., Guadalupe and Tempe, Arizona

This was a special population with no subjects in the middle class. Many of the tests carried out on the other populations could not be carried out.

(I) Age vs. Art Score

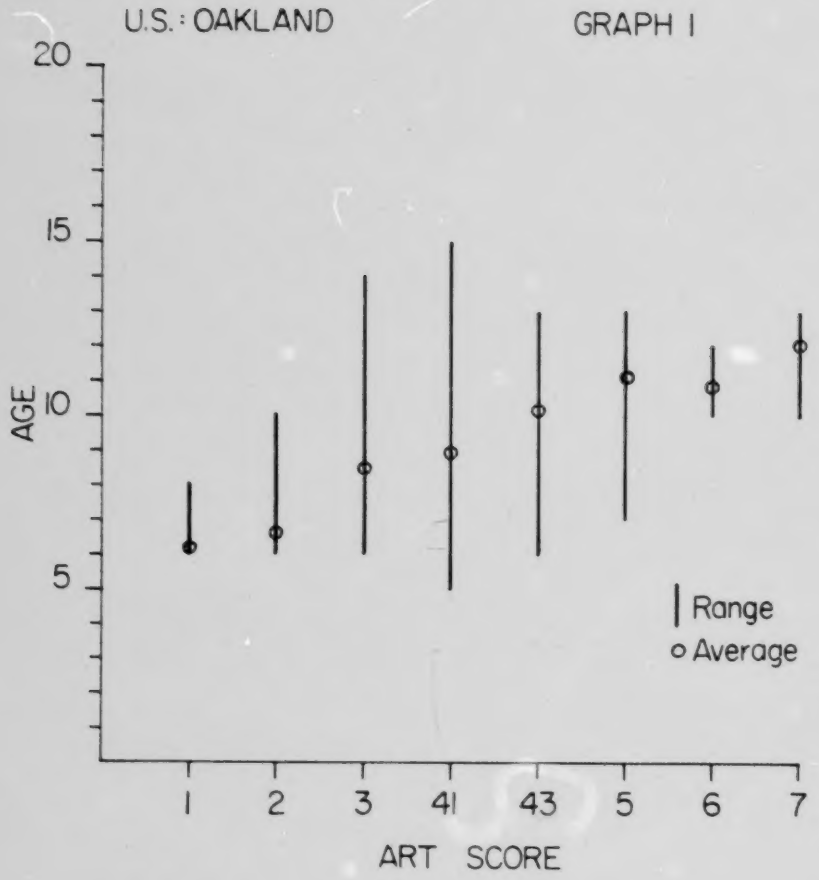
1(a) Total population: average age is an increasing function of art score

1(d) Males: same conclusion as above

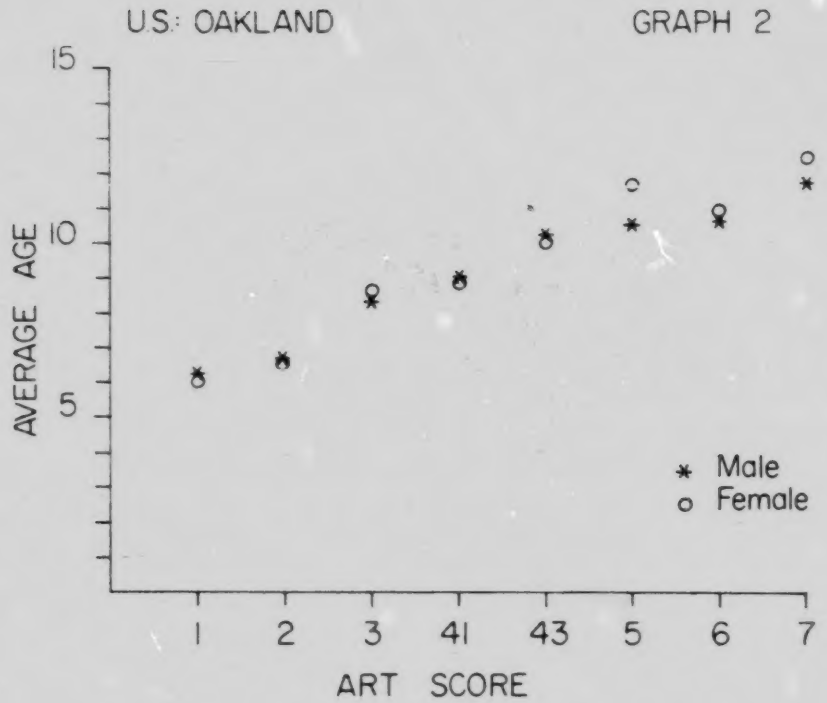
1(e) Females: almost same as above (slight dip in average age at art score 5 based on 3 observations)

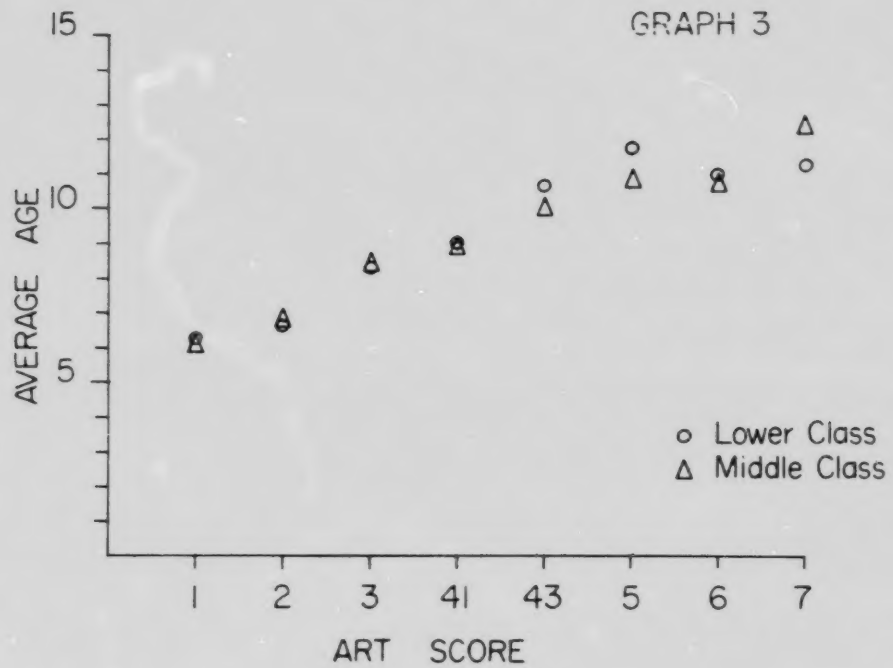
There is no significant difference in art scores between males and females.

30239


U.S.: OAKLAND
GRAPH I
20
15
10
5
AGE
Range
Average
1
2
3
41
43
5
6
7
ART SCORE

96230


U.S. OAKLAND
GRAPH 2
AVERAGE AGE
15
10
5
* Male
o Female
1
2
3
41
43
5
6
7
ART SCORE


GRAPH 3
AVERAGE AGE
15
10
5
o Lower Class
Δ Middle Class
1
2
3
41
43
5
6
7
ART SCORE

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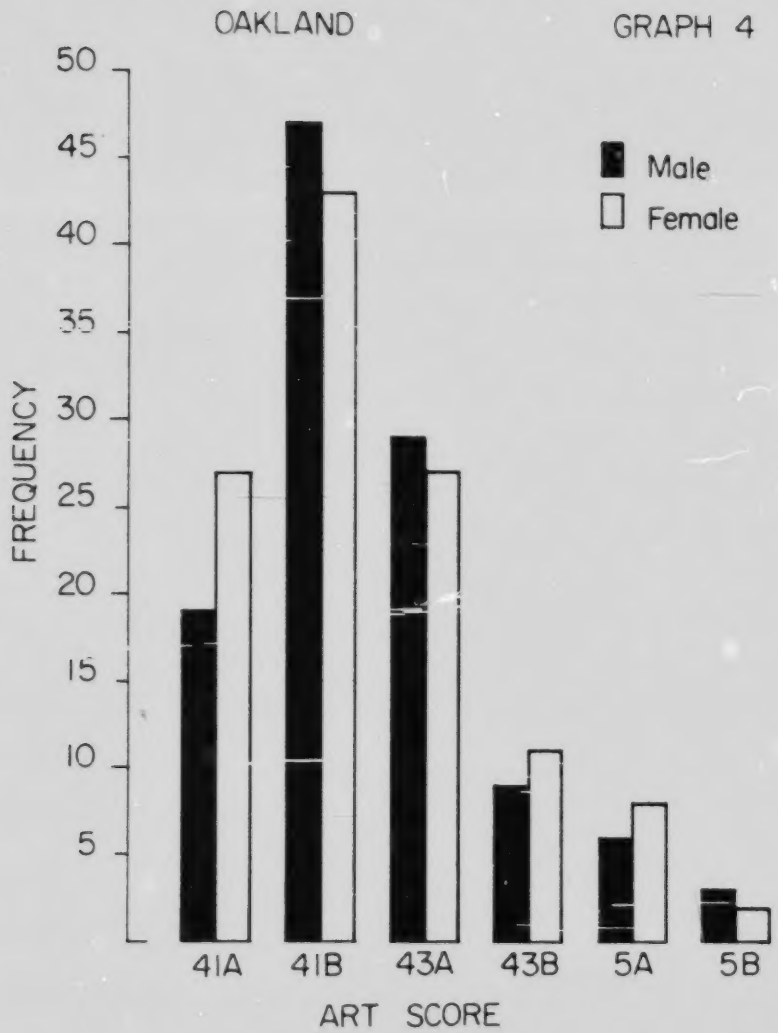
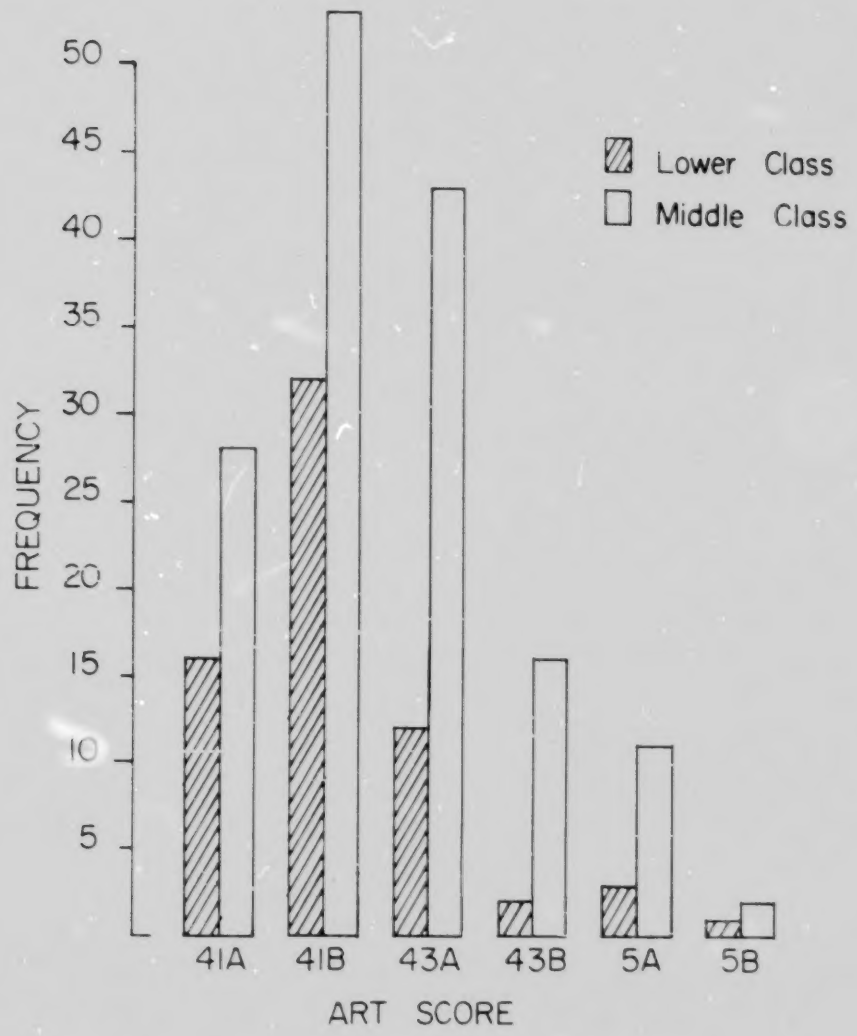


96231

U.S.: OAKLAND GRAPH 5



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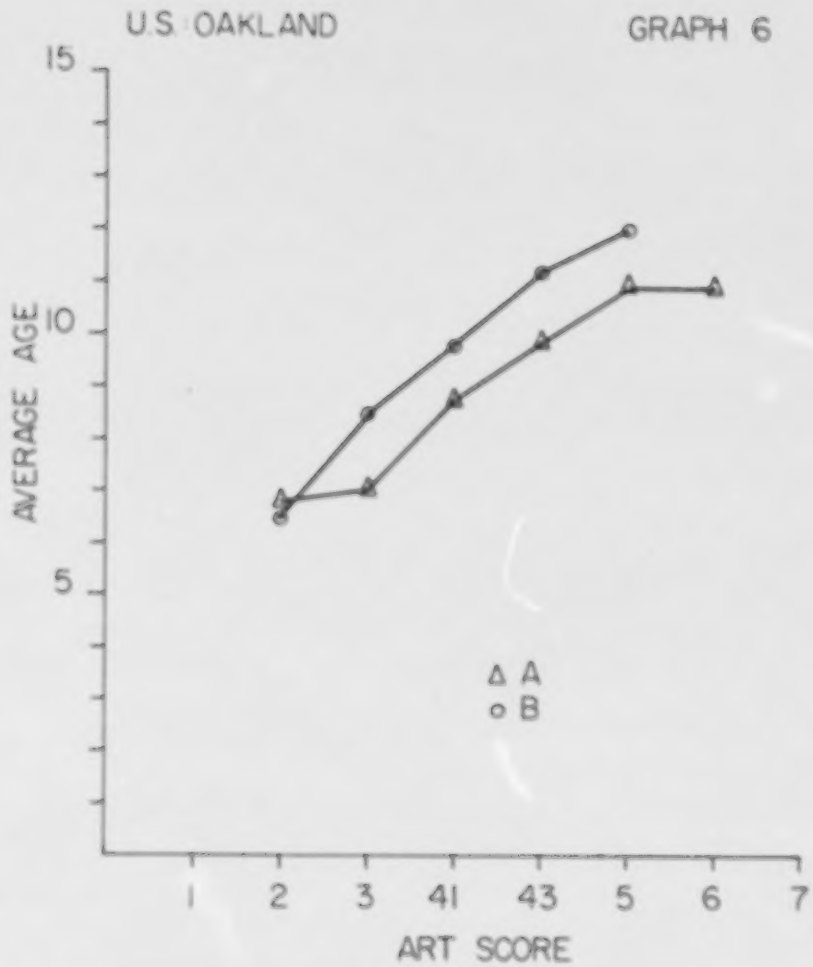

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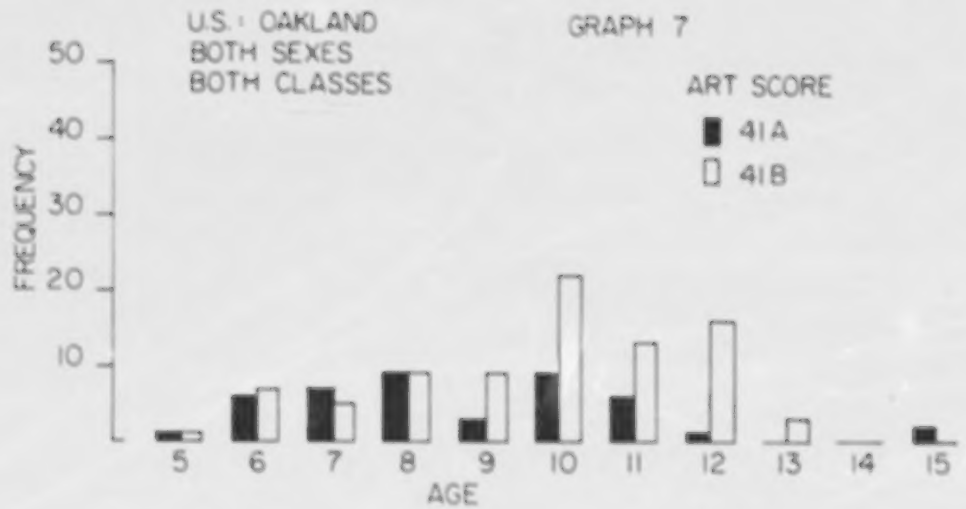
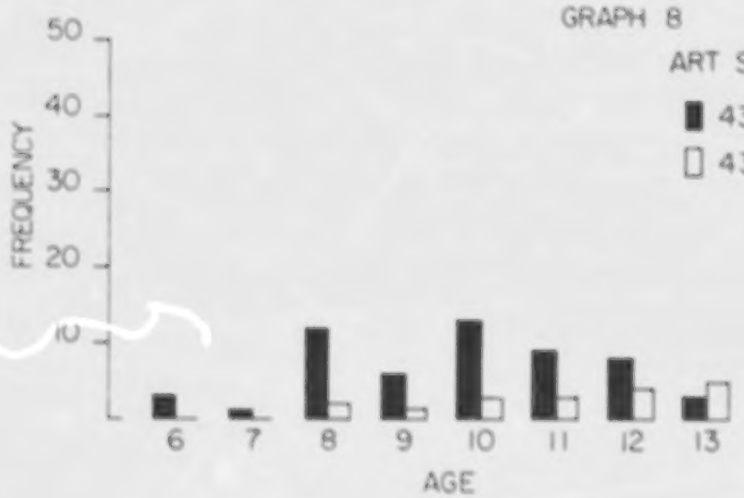

U.S. - OAKLAND
BOTH SEXES
BOTH CLASSES
GRAPH 7
ART SCORE
41A
41B
FREQUENCY
50
40
30
20
10
5
6
7
8
9
10
11
12
13
14
15
AGE


GRAPH 8
ART SCORE
43A
43B
FREQUENCY
50
40
30
20
10
6
7
8
9
10
11
12
13
AGE

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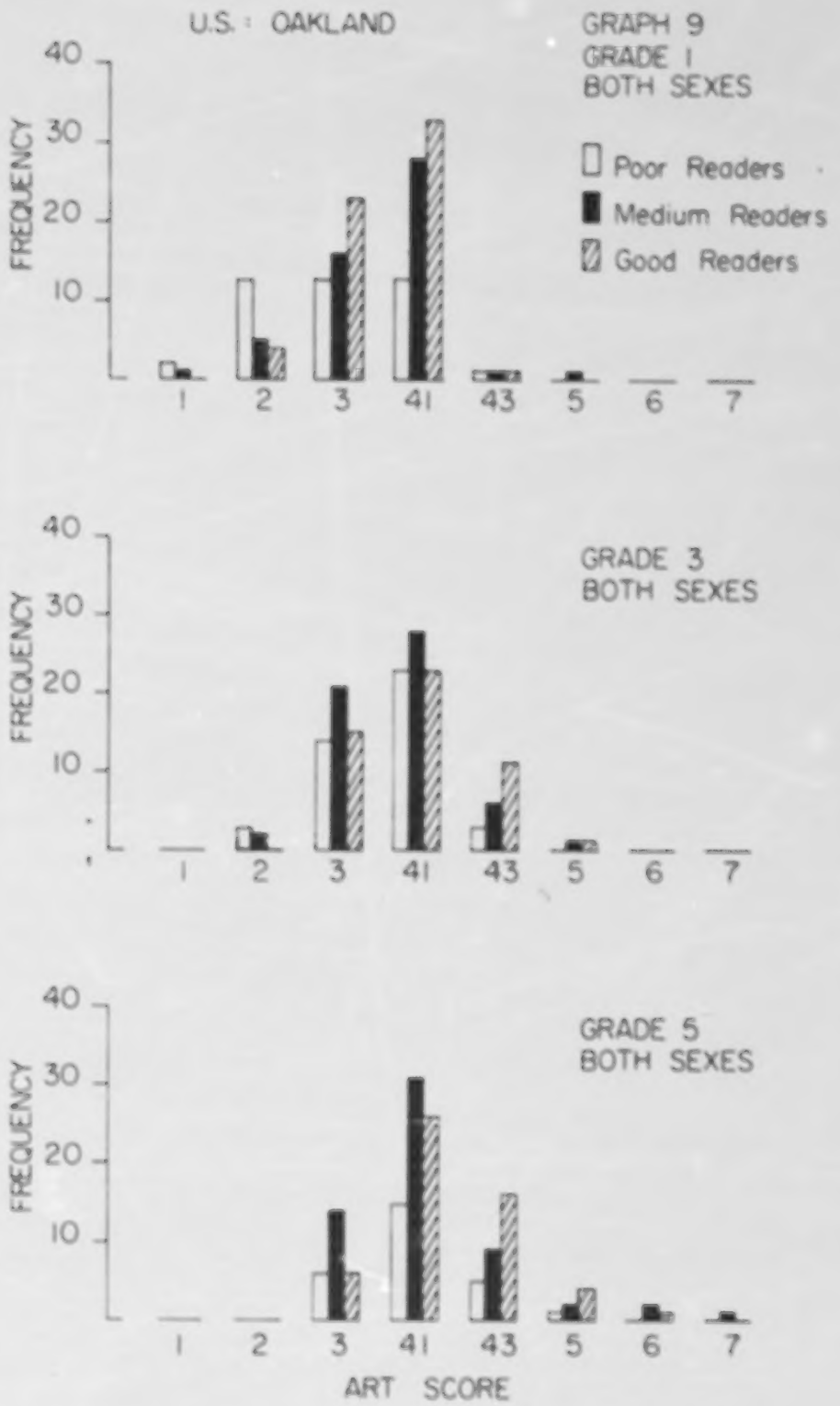

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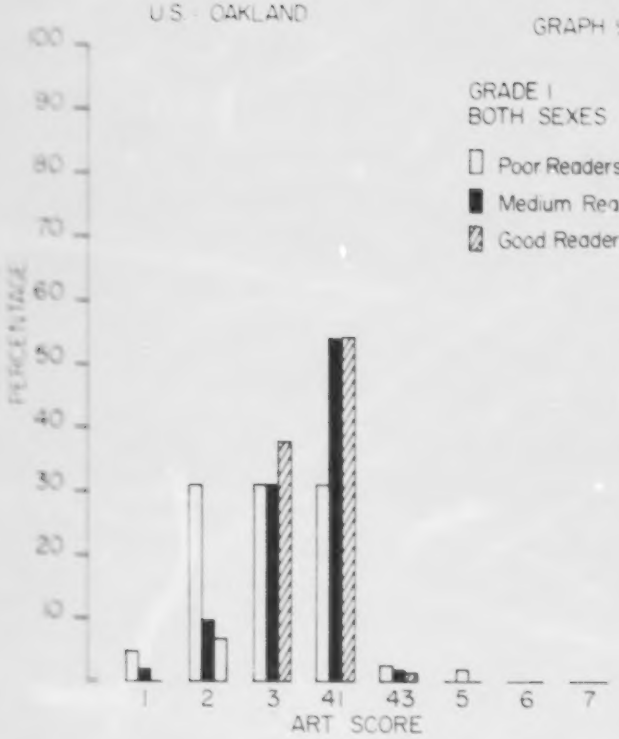
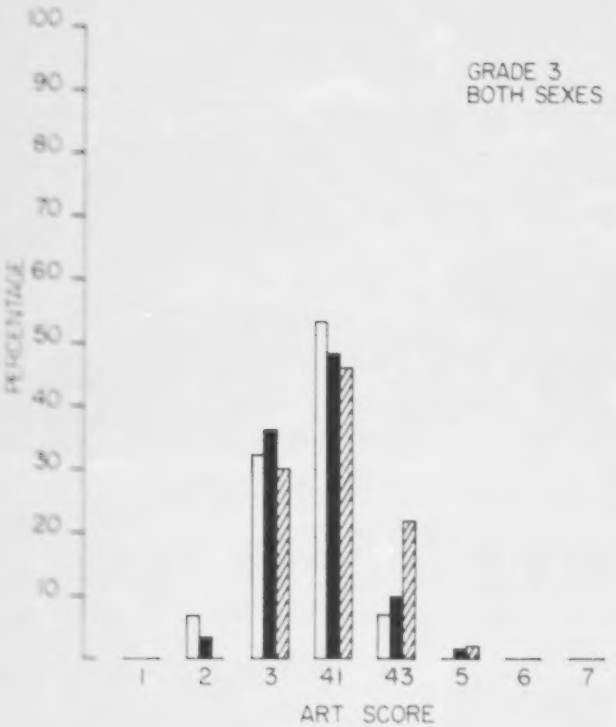
U.S. - OAKLAND

GRAPH 9a





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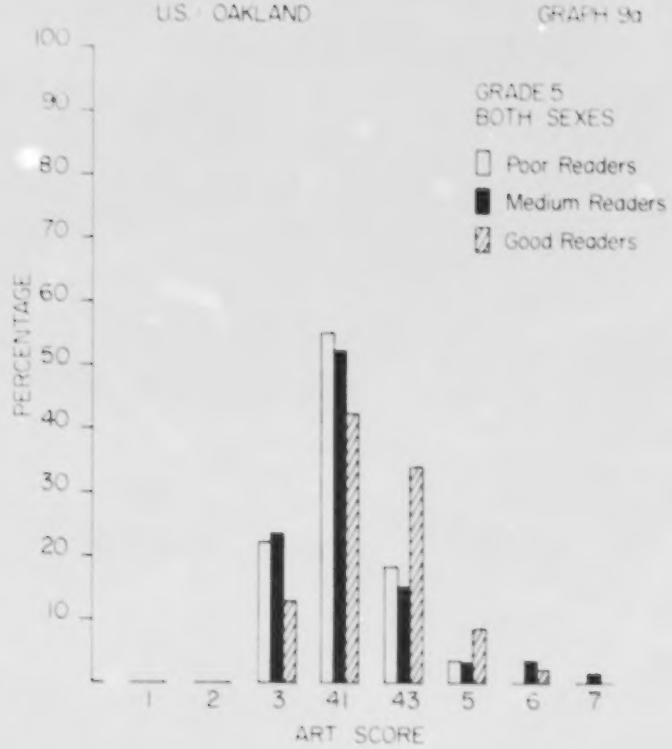
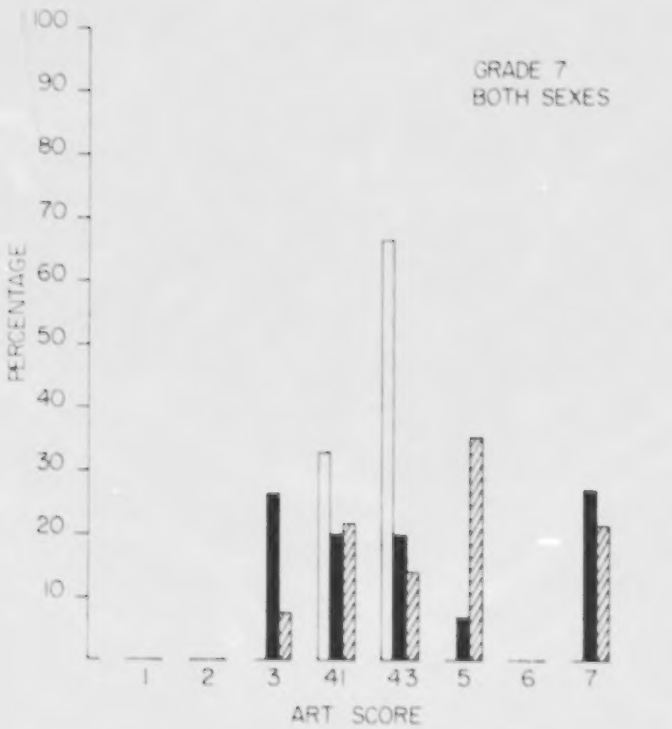
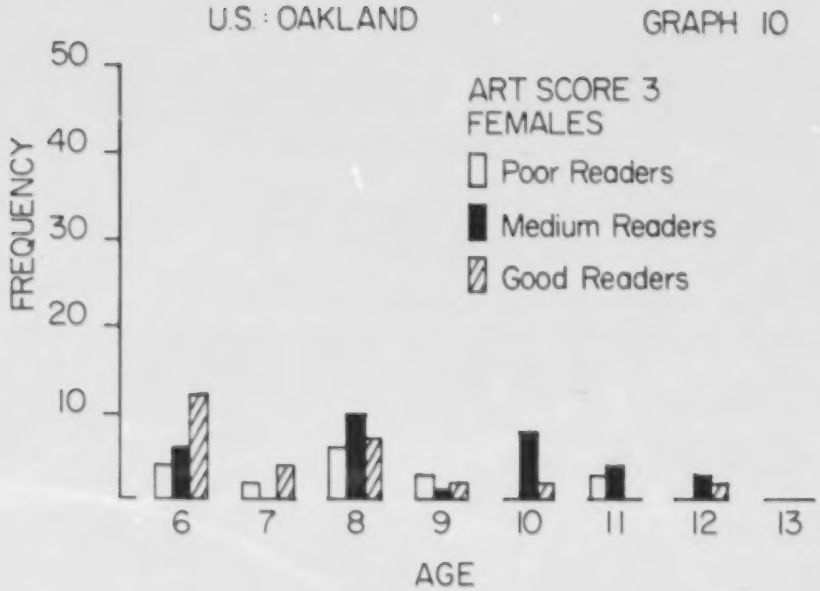
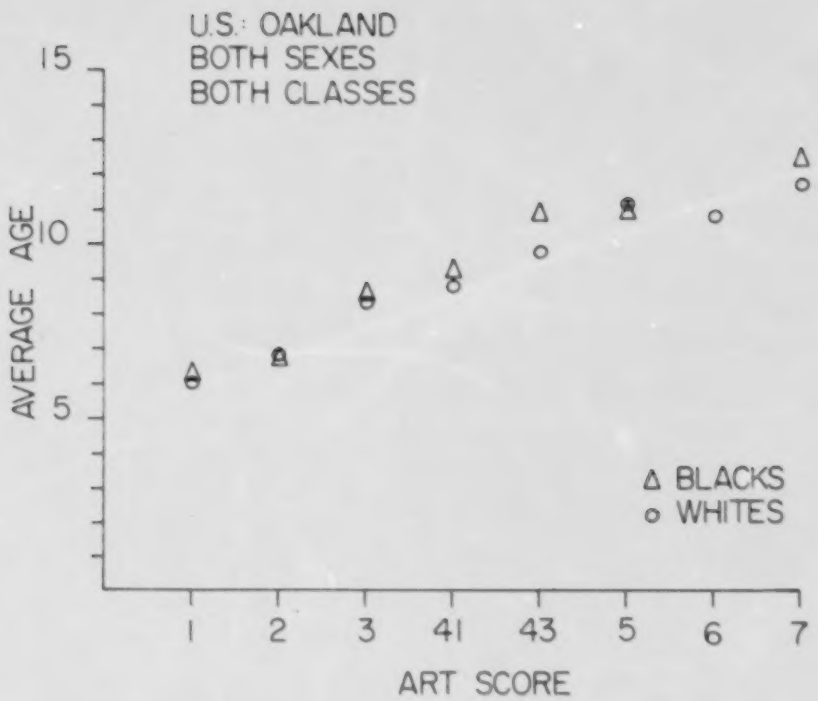
U.S. - OAKLAND GRAPH 9a






U.S : OAKLAND
GRAPH 10
ART SCORE 3
FEMALES
Poor Readers
Medium Readers
Good Readers
FREQUENCY
50
40
30
20
10
6
7
8
9
10
11
12
13
AGE

00235


U.S.: OAKLAND
BOTH SEXES
BOTH CLASSES
15
10
5
AVERAGE AGE
Δ BLACKS
o WHITES
1
2
3
41
43
5
6
7
ART SCORE

10239

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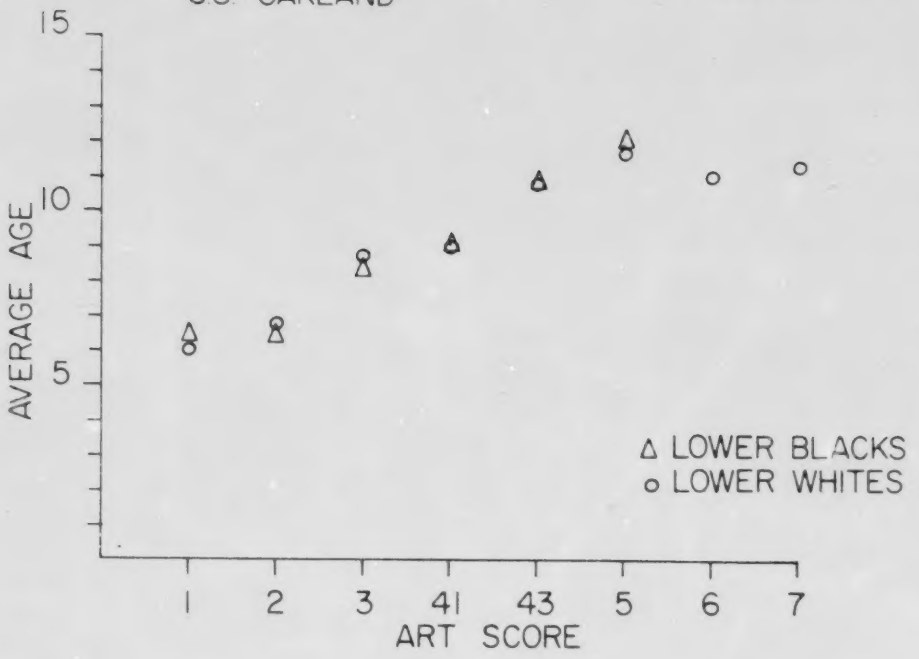

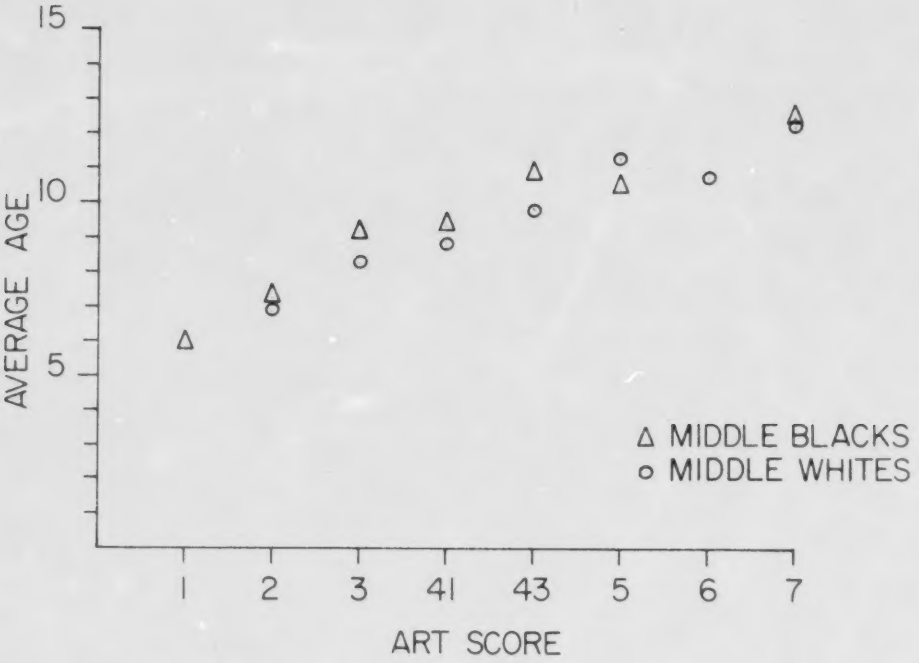

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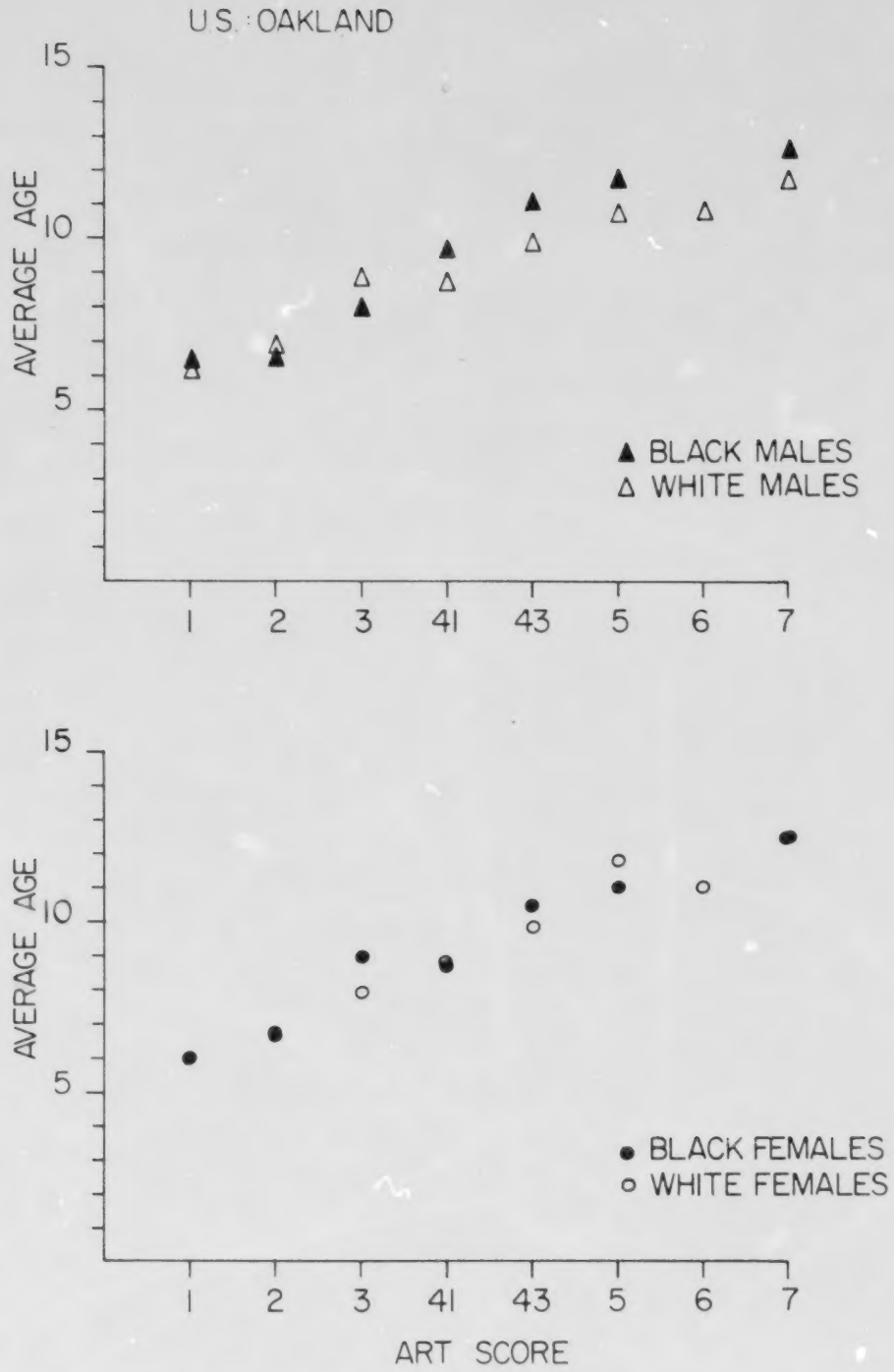
U.S. : OAKLAND
AVERAGE AGE
15
10
5
▲ BLACK MALES
△ WHITE MALES
1
2
3
41
43
5
6
7
AVERAGE AGE
15
10
5
● BLACK FEMALES
○ WHITE FEMALES
1
2
3
41
43
5
6
7
ART SCORE

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U. S. A., Oakland, California

	Lower	Middle	
Male	153	189	342
Female	183	193	376
	336	382	718

(I) Age vs. Art Score

1(a) Total population: average age is increasing function of art score (Dip at art score 6 based on only 5 observations)

1(b) Lower class: same conclusion as 1(a) (Dip at 6 based on 2 observations)

1(c) Middle class: same conclusion as 1(a)

1(d) Males: average age is increasing function of art score

1(e) Females: same conclusion as 1(a)

(II) Class Differences

For each grade, art score and class were examined. There is a significant difference between the art scores of the middle and lower class for grades 1, 3 and 5, middle class children tending to have higher art scores.

Males: the differences between classes are significant for these three grades.

Females: same conclusion as for males.

The difference is most striking in grade 1 (where an estimate of the shift in score is +1 for the middle class).

For grade 7 the differences are not statistically significant.

(III) Comparison of Lower and Middle Class Age Distributions at Each Art Score

There were no significant shifts in the age distributions of the lower and middle class in these comparisons.

(IV) A/B Style Comparisons

(a) 41A/B

Overall population: there was a significant shift in the age distribution (the shift estimated as 1 year) between 41A and 41B type children, the 41B's tending to be older (41B distribution

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shifted to the right).

When examined by class: difference is significant for lower class but not for middle class.

When examined by sex: difference is significant for females but not for males.

When examined by sex and class: difference is significant for lower class males and lower class females.

(b) 43A/B

Overall population: there is a significant difference in the age distribution. B types tend to be older (estimated shift 1 year).

When examined by class: for middle class we have significant difference.

When examined by sex: for females we have significant difference.

When examined by sex and class: for middle class females we have significant difference.

(c) 5A/B

Overall population: no significant difference.

(V) Reading Score Comparisons

In the overall population comparison of art scores for poor, medium and good readers grades 1, 3 and 5 gave significant results, i.e., good readers tend to have highest art scores and poorest readers tend to have lowest art scores. The difference is most striking in grade 1. In grade 1 the male population gives significant results. The only female group that gave a significant result was those in grade 3.

Are there significant shifts in age distribution among the three groups of readers for the various art scores? Only females having art score 3 show a significant shift.

Supplemental Comparisons Related to Race

Average age vs. art score:

When the total population was split by race, for both Blacks and non-Blacks the average age for each art score was approximately an increasing function of art score. (There was a dip in the non-Black population at art score 6 based on 5 observations.)

When split on race for the lower class alone and for the middle class alone the conclusion remained the same as above.

When split on race for each of the sexes separately the conclusion was the same as above.

Differences on art scores:

The total population was examined grade by grade. The distribution of art scores of non-Blacks vs. Blacks was examined for each grade. For grades 1, 3, 5 and 7 the distribution of art scores for non-Blacks was shifted to the right. The differences in the average scores (average for non-Blacks - average for Blacks) were .6, .3, .3 and 1 respectively for the four grades considered. However, when the population was split by class and the distribution of Black/non-Black art scores examined for each grade and class the following features were noted:

For the lower class: the distribution of art scores for non-Blacks is shifted to the right for grade 1. There is no significant difference for grades 3, 5 and 7.

For the middle class: there is a shift to the right for grades 1 and 7 and no significant shift for grades 3 and 5.

Art score as a function of reading ability:

Do good readers tend to have the highest art scores, medium readers the next highest art scores and poor readers the poorest art scores? The distributions of art scores for the three groups of readers were examined and the answer to the question raised is yes for the following cases:

Total population: grades 1, 3 and 5

Blacks: grade 1

Non-Blacks: not significant for any grades

U. S. A., Palo Alto, California

This was a special population including a total of 169 children. Each child drew three pictures.

The only children to switch from an A to B or B to A type were the following:

Grade	Sex	Age	
1	female	6	(see note on code sheet)
3	female	8	
5	male	10	
5	male	12	
5	male	12	

These children all drew at the Stage 4 level.

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IV CONCLUSIONS AND DISCUSSION

Age vs. Art Score

Three observations of interest appear in the examination of age vs. art score results. First of all, the mean age is higher at entering concrete operations than that suggested by Piaget. Second, the range--as Dodwell (1963) found--is very large at every stage. Third, an overwhelmingly large proportion of all children are found at the 41 level. It would appear that the problems of representational structuring of a Euclidean vertical/horizontal reference system, coordination of points of view, and three-dimensional rendering within a plane, are not solved by most children in this study.

Of special interest in terms of the age/art score sequence is the slight dip in age which occurs quite uniformly at Stage 6 and occasionally at Stage 5 or 7. This could be due to the very small size of the sample at the upper end. Stage 6 drawings (The Space Cell) cannot be out of place sequentially because they involve refinement of the Stage 5 plane. They do, however, generally represent the culmination of untutored drawing development.

Two factors may be operating here. First of all, it is generally recognized in art education literature that a decline in art ability and interest appears in the work of the older child[1]. This is usually attributed to social and academic value emphasis on verbal skills in the middle and upper grades, and also to the child's frustration and discouragement over his inability to solve the problems of visual realism.

Unfortunately in almost all school systems this critical period takes place under the "guidance" of the regular classroom teacher who usually has had no special art training and may have little interest, and even less understanding of the important problem-solving challenges involved.

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[1] See Harris (1963, pp. 182, 230). See also his review of Burt's (1921) explanation (1963, pp. 17-19).

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It may be, therefore, that mostly talented younger children reach Stage 6 in the normal course of development, whereas discouraged or verbally-oriented older children cease to exert themselves.

Then, too, in most societies this stage occurs around the time that the child enters junior high school. In many societies this also heralds the time when his academic future is determined, that is, whether a vocational or college preparatory course is indicated. Since verbal skills are highly valued in these placement evaluations, it is likely that achievement-oriented children would concentrate on this form of expression and communication rather than on the graphic.

In junior high school most children experience art training with a special art teacher. Thus those who are still interested have this opportunity to learn the kinds of skills associated with Stage 7 performance.

The curious age dip at Stage 4l for Italian girls may be explained by the fact that approximately 63% of the six-year-old first graders drew very simple transitional base line C type drawings. It may be remembered that in one of the three primary schools the principal is very interested in emphasizing art, and in another primary school the first grade teacher uses the Montessori method and allows the children to spend most of their time in drawing activities.

Italian girls also drew more A type than B type drawings at this stage, contrary to the overall trend. There is no information given which might suggest why these observations are true for girls alone. The sexes are segregated by classroom and it may be that more of the girls' teachers encourage certain drawing behaviors.

Class Differences

It has been noted earlier that although the Amazon Indian drawings could not be examined in terms of social class, degree of contact with civilization could suggest differences in performance. Hence they were sorted according to the same criteria as those used for other populations. Within their own cultural

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range, those groups which were most developed had the higher art scores.

A further study of mythological classification would seem to be indicated in order to answer such questions as the following: Are women and fish grouped together and set apart from other elements? Are armadillos or birds pictured in drawings where human and animal (village and forest) elements are juxtaposed or mixed? Did men draw fish whereas no women did because of mythological taboos restricting female contact with water elements? etc.

Nearly all elements in the Amazon Indian drawings appear as stylized forms or as signs. Without familiarity with this idiom, particular species could not be distinguished, nor could sign meanings be understood. Thus the possible development of classification skills based on mythological groupings could not be determined. The importance of exploring art forms of other cultures is well described in the Devereux and La Barre section, "Art and Mythology" in Kaplan (1961).

In terms of social class differences, the most striking exception to the general trend occurred in São Paulo, Brazil, grades 3 and 5. Here the lower class was significantly higher, although significantly behind in the first grade.

There may be two explanations. First of all this particular lower class school appears to be unique in that the Department of Educational Psychology of the University of São Paulo is working with them in the development of an educational guidance service. Thus, although the children start school with social class disadvantage, it appears that by third grade the enriched program, interest, and stimulation provided have had a strong positive effect on performance.

It may be recalled that primary school is compulsory only through fourth grade at which time many lower class children drop out. Those who continue are thus a select group. In addition, since they tend to go to the vocational school starting with fifth grade, they have the benefit of a trained art teacher every day whereas the middle class students study art only twice a week.

Beyond this grade there seems to be no significant difference between the art scores of the two social groups, the middle class children doing as well on only two days of art per week as the lower class do on five.

Denmark, being a rather homogeneous society, was expected to show little social class difference. It was discovered that somehow, inadvertently, no middle class children were tested at all. In their place were the upper class children of professionals, owners of large enterprises, etc. Since all children alike are exposed to the same school program, the consistent difference noted at each age level must be related to a more enriched and stimulating home environment in the upper class group.

It was anticipated that Saarbrücken would show little or no social class difference and this proved to be the case. The same is true of Greenland where all children attend comparable schools and show a similar set of social values and opportunities. Thule, where differences might have been expected, showed the same level of performance. However, these children lived in a boarding school where the headmaster was a particularly devoted educator. Thus, it appears their performance may have been more affected by their enriched school environment than by their vacation period nomadic home life.

In Hong Kong lower class children do not have a trained art teacher until junior high school, at which time there appears to be no statistical difference in art performance between the two groups. Up to that point the difference, as expected, was striking.

India was expected to show great difference between social classes and the difference proved to be striking.

A description of the schools in Italy suggests that great variety exists in the amount and kind of art training provided from school to school and in classrooms segregated by sex. One middle class fifth grade and two middle class seventh grade schools place special emphasis on art training.

No difference should have occurred in Japan because there appears to be no large alienated lower class, all children sharing

alike their common cultural standards and values[1].

In the two U. S. A. populations differences between SES classes (exaggerated by ethnic social disadvantage) were generally significant as was expected.

A/B Style Comparisons

Further research in the area of drawing style is indicated by a number of current studies (as mentioned in the introductory section). Observation of differences--but not explanation--was built into the design of the present study.

It is noteworthy that in both social classes and sexes, the overall shift from a B style to an A style appeared to be the choice of older children, although all styles appeared at every age level and in every group.

It might be fruitful to examine the relationships between drawing styles (as described in this study) with styles described in theories of the visual/haptic and field dependent/independent.

Reading Score Comparisons

The statistical findings in this section may have been affected in two ways: one, there were a variety of methods used to determine reading ability (including teacher's overall subjective evaluation) and two, reading was held as the constant by grade and the art score was then looked at. Because most grades are generally more homogeneous in reading ability than in drawing development--reading being an important placement criteria--this statistical approach can give different results from those appearing when the art score is fixed and reading ability is examined against it.

In the one instance where this was tried, a significant correlation appeared at the 41 level which had only seemed to be a general trend before. Re-examination of the data fixing art score would seem to be indicated[2].

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[1] This homogeneity shows up in the area of projective testing also (e.g., the Thematic Apperception Test). For a detailed discussion of this cultural phenomenon, see De Vos and Wagatsuma, The Heritage of Endurance (in press).

[2] Unfortunately, this statistical possibility was only entertained during the last few days of the study and could not be explored further at that time.

Summary

Some rather obvious conclusions suggest themselves in a consideration of the findings of a study such as this.

Each child can only represent himself; each classroom only that classroom; each school only that school; each city only that city; and each country only that country. Although interesting trends may appear which suggest useful areas of study to be explored in greater detail--substantiated or challenged by replication--they are merely trends, trends which are dependent upon the particular samples included in a huge cross-sectional study.

For more precise knowledge, a longitudinal study should be carried out along the urban-rural continuum of entire areas in which local investigators record specific, familial, cultural, educational, and environmental influences acting upon the performance of individual subjects.

It might be especially interesting to compare drawing performance with other Genevan spatial tasks, and to re-examine the correlation between verbal and drawing skills using more consistent standard tests of verbal ability.

Replication should certainly involve collecting several drawings at a time per child to better understand the problems with which he is struggling and the trial and error learning involved. There should be no time limitations, and discussions (not suggestions) about the drawings should be recorded.

Unfortunately, the major impact of studying thousands of drawings from all parts of the world cannot be measured on any scale, nor its poignancy expressed. The contrast between joy, fullness, conceptual richness, and expressive vitality on the one hand and converse impoverishment on the other is a painful confrontation each time it appears. Tragically, it is repeated over and over in drawings from children throughout the world wherever unequal nurturance persists.

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* The name, Margaret Zawadski, appears on the top of page 5. Unfortunately, it is an incorrect reference. The film was made by Grace Petitclerc. It should be changed on page 5 also. The details of the above reference are correct but should be attributed to Petitclerc. There should be no entry for a Zawadski.

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APPENDIX 1

Research Participants

Data collection was arranged through the cooperation of the following:

Brazil, Amazon area Cururu, Bocco, and Tiriyos	Dr. and Mrs. Edward Stalzer Chicago, Illinois (See Appendix 2) Dr. Stalzer was then surgeon at St. Joseph's Hospital; Mrs. Gisela Stalzer is a trained archaeologist. Now: 2770 Sudderth Drive P.O. Drawer E Ruidoso, New Mexico 88345
Brazil, São Paulo	Professor Arrigo L. Angelini Universidade de São Paulo Faculdade de Filosofia, Ciências e Letras Caixa Postal, 8.105 São Paulo Res. Asst: Mrs. Arrigo L. Angelini, professional psychologist (private)
Denmark, Copenhagen	Dr. Svend Skyum-Nielsen Danish National Institute Social Research 28 Borgergade Copenhagen K Res. Asst: Leif Aidt, then graduate student in psychology, later art teacher in Greenland, now Supervisor of Greenlanders being educated in Denmark, Department of Greenlandic Affairs, Copenhagen, Denmark
Germany, Saarbrücken	Professor Ernst E. Boesch Psychologisches Institut der Universität des Saarlandes Saarbrücken D-66-SB-15 Res. Asst: Paul R. Baltes, then Dipl. Psych., now Associate Professor and director of the Division of Individual and Family Studies, College of Human Development, Pennsylvania State University, University Park, Pa. 16802

Greenland, Thule and Egedesminde	Mr. Chr. Berthelsen Director of Public Schools Godthåb Res. Assts: Leif Aidt (see Denmark) and Lars Møller Lund, Headmaster of school in Thule, now in Godthåb
Hong Kong	Mrs. Anita K. F. Chen Li Department of Education Hong Kong University Hong Kong Res. Asst: Tsoi Heung Sang, then graduate student in education, now Education Officer, Education Department, Hong Kong
India, Bombay	Professor J. M. Fuster, S. J. Psychology Department Saint Xavier's College Bombay, 1 (BR) Res. Asst: Homer Pithawalla, then honor psychology major, now attorney with the legal firm of Mulia & Mulla and Craigie Blunt & Caroe, Bombay, India
Italy, Milan	Professor Marcello Cesa-Bianchi Instituto de Psicologia Sperimentale della Facoltà Medica Università degli Studi di Milano Via Fabio Filzi N. 20 Milano Res. Asst: Dr. Gabriella Rubini, staff member of the Institute
Japan, Tokyo	Professor Akira Hoshino Department of Psychology International Christian University 10-2, Osawa, 3-Chome Mitaka Tokyo Res. Assts: Haruo Nishimura, then graduate student in psychology, now interdisciplinary researcher and graduate school criminology instructor, Tokyo; and Koichi Hasegawa, then graduate student in psychology, now Assistant Professor of Psychology, Aoyama Gakuin University, Tokyo

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U.S.A., Cincinnati, Ohio	Mrs. Betty B. Montgomery Day Care Consultant Department of Public Welfare Now: Head Teacher Apple Tree Nursery 220 William H. Taft Road Cincinnati, Ohio 45219
U.S.A., Guadalupe, Arizona (Yaqui Indians)	Professor Max Rennels Department of Art Education Arts Building Arizona State University Tempe Arizona Assisted by Mr. Joseph Salazar, art instructor, public schools, Tempe, Arizona
U.S.A., Palo Alto, California	Dr. Winfield Christensen Elementary School Principal Palo Alto Data collected by B. Hess-Behrens
U.S.A., Oakland, California	Edwin Larsen Research Director Oakland Public Schools Edward Hakkarainen Consultant for Information Systems Data collected by B. Hess-Behrens

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42 CHICAGO SUN-TIMES, Fri., May 13, 1966

Doctor And Wife Returning To Jungle To Aid Rescuers

By Abra Prentice

Dr. Edward V. Stalzer is sticking to his code of "one good turn deserves another."

DR. EDWARD V. STALZER

He is returning to the Amazon jungle to look after the Brazilian Indians who rescued him a year ago when his plane crashed in the heart of the jungle.

Dr. Stalzer and his wife, Gisela, of 1037 W. North Shore, were on a holiday, traveling with friends in two private planes. Both planes were forced to crash-land 500 miles south of the Amazon River near the small village of Barra do Rio Sao Manuel.

Paddled From Interior

From that point, Indians guided the party of eight through the dense interior until the Brazilian air force flew them out 12 days later.

The health of these Indians, who shared their food and paddled his group up small rivers, worried Dr. Stalzer. He later learned that many of them were dying from smallpox, tuberculosis and other diseases.

In June, the doctor will return to Brazil with other trained personnel and medical supplies to establish the Cururu Medical Mission Society.

Medical Outposts

The society, formed by Dr. Stalzer, is made up of doctors, nurses and members of the Flying Physicians Assn. Their plan is to set up medical outposts along the Cururu River where Indians have no help except from the tiny Franciscan mission at Cururu.

Dr. Stalzer will fly his group to Santarem, 500 miles northeast of Cururu, and establish headquarters. From there the staff will travel by boat up the Tapajos and Cururu rivers.

"The boat will serve as a floating clinic," Dr. Stalzer said. "Our purpose is preventive medicine — smallpox vaccinations and TB control."

Rotation For Personnel

Eight persons will make the first trip to Brazil and stay for three to four months. A second group will replace them in October.

This rotation system is an important factor, said the doctor, adding, "No one could stand the adverse conditions in the jungle for a year, although it would be less expensive to keep the same personnel for a longer period of time."

Eventually Dr. Stalzer hopes to build a permanent headquarters for the society. He estimated that his work will encompass an area of 1,000 miles in the deepest part of the jungle in the state of Para. Some 7,000 Indians live in the area, he believes.

Dr. Stalzer said there has been a great deal of interest in his project from doctors across the country who want to make the trip.

Accompanying him on the first trip will be his wife, Dr. and Mrs. James Maly of Fullerton, Neb., who were in the plane crash last year, three nurses and a medical student.

Dr. Stalzer will return to Chicago in August. He hopes to find a doctor to head the Cururu society as a full-time job in Brazil.

NOTE: Data collection was arranged on the return trip described herein.

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APPENDIX 3

List of Paper-and-Pencil Tests of Spatial Ability

(after I. MacFarlane Smith, 1964)

Test	Author(s)	Approx. Pub. Date
Maze Test	S. D. Porteus	1915
Copying and Drawing from Memory	A. Binet	1917
Picture Completion	R. Pintner, M. M. Anderson	1917
Army Group Intelligence (Beta) including spatial subtests such as paper form-board	U.S. Division of Psychology	1918
Mental Manipulation of Space Relations	H. N. Irwin	1918
Matching Solids and Surfaces	A. L. Rogers	1918
Spatial Relations, A and B	L. L. Thurstone	1918
Hands Test	L. L. Thurstone	1918
Engineering Aptitude Test	L. L. Thurstone	1918
Drawing a Man	C. Burt	1921
Figure Orientation (Chelsea Tests)	P. B. Ballard	1922
Imagery Test	C. H. Griffiths	1924
Mechanical Ability (tracing, tapping, dotting, copying, blocks, pursuit)	T. W. MacQuarrie	1925
Form Relations (N.I.I.P.)	A. Macrae	1926
Memory for Designs (N.I.I.P.)	F. M. Earle	1926
Drawing a Man	F. L. Goodenough	1926
Embedded Figures	K. Gottschaldt	1926
Form Discrimination	C. B. Davenport	1927
Visual Designs	F. W. Ellis (modified by M. E. Goudge and H. W. Crane)	1927
Visual Designs	W. Healy	1927
Spatial Relations Examination, Problem 4 (Paper-folding)	L. L. Thurstone, W. B. Jones	1927
Minnesota Mechanical Ability Test (including paper form-board)	D. G. Patterson, R. M. Elliott, L. D. Anderson, H. A. Toops, and E. Heidoreder	1928
Spatial Representation	O. Julian	1928
Visualization	E. Claparède	1929
Gestalt Completion	R. F. Street	1931
Visual Perception (figure classification)	C. Spearman	1932
Spatial Relations (cube-counting, matching)	C. C. Brigham	1932
Revised Minnesota Paper Form-board	R. Likert, W. A. Quasha	1934
Overlapping Shapes	W. Stephenson	1935

Test	Author(s)	Approx. Pub. Date
Overlapping Shapes (with directions)	A. A. El Koussy	1935
Area Discrimination	A. A. El Koussy	1935
Form Equations, A, B and C	A. A. El Koussy	1935
Correlate Education, A and B	A. A. El Koussy (after Spearman)	1935
Band Completions	A. A. El Koussy (after Spearman)	
Spatial Analogies	A. A. El Koussy (after Stephenson)	1935
Pattern Perception (cross patterns)	W. Stephenson	1935
Visual Motor Gestalt	L. Bender	1938
Primary Mental Abilities (Spatial subtest)	L. L. Thurstone, T. G. Thurstone	1938
Shapes Test (N.I.I.P.)	P. Slater	1940
Recognition of Designs (N.I.I.P.)	P. Slater	1940
Group Test 80A (N.I.I.P. Mental manipulation of shapes)	P. Slater	1943
Survey of Space Relations Ability	H. W. Case and F. Ruch	1944
Squares Test	(after Rybakoff)	1944
Chesterfield Test (Spatial section, including squares, square completion)	C. Spearman	1944
Survey of Object Visualization	D. R. Miller	1945
Visual Retention for Clinical Use	A. L. Benton	1946
Memory of Designs	F. K. Graham, B. S. Kendall	1946
Differential Aptitude Test (Space relations subtest)	G. K. Bennet, H. G. Seashore, and A. G. Wesman	1947
Spatial Visualization (visualization of rotated clock)	W. S. Zimmerman	1947
Spatial Orientation (orientation of boat)	J. P. Guilford, W. S. Zimmerman	1947
General Aptitude Test Battery (Spatial aptitude subtest)	U. S. Employment Service	1947
Moray House Space Test I (square and cube counting, overlapping shapes, reflected forms, block completion)	G. H. Thompson, J. H. Gray, J. Y. Erskine, J. T. Bain, L. F. Mills, and W. G. Emmett	1947
Duplex Series of Ability Tests: Nos. 3 & 4, Part II (Mathematical and Mechanical Aptitudes)	F. M. Earle	1947
Technical Selection Test T.S.8 (pattern checking)	E. A. Peel	1948

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Test	Author(s)	Approx. Pub. Date
Technical Selection Test V.S.10 (pattern checking)	E. A. Peel	1948
Object Aperture Test (space visualization)	P. H. Du Bois, G. Gleser	1948
Mathematical and Technical Test (including memory for designs subtest)	J. L. Park	1948
Group Test 81 (N.I.I.P.) (cross pattern and dissecting shapes)	P. Slater	1949
Spatial Test II (N.F.E.R.) (match boxes, shapes, models, square completion, paperfolding, block building)	A. F. Watts, D. A. Pidgeon, and M. K. B. Richards	1951
Spatial Test I (N.F.E.R.) (dissecting shapes, embedded figures, cross-pattern, shape recognition, form analogies, inverse drawing)	I. MacFarlane	1952
Paper Form Board (Vs-1)	L. L. Thurstone	1952
Punched Holes (Vz-2)	L. L. Thurstone	1952
Surface Development (Vz-3)	L. L. Thurstone	1952
McGill Closure Test (gestalt completion)	C. M. Mooney	1954
Differential Test Battery (shapes subtest)	J. R. Morrisby	1955
Flags Test (revised)	L. L. Thurstone, T. E. Jeffrey	1956
Aptitude Classification Tests (S.R.A.) (assembly and identification of components, subtests)	J. C. Flanagan	1957
Spatial Test 3 (N.F.E.R.) (sections, plans, projections and nets of solid objects)	I. MacFarlane Smith, J. S. Lawes	1959
Object Completion Space Form (completion, shapes and models)	J. W. Curtis	1960
Development Test of Visual Perception (eye-motor coordination, figure-ground, form constancy, position in space, space relations)	M. Frostig	1961

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Samples of Items from Spatial Tests (after I. MacFarlane Smith, 1964)

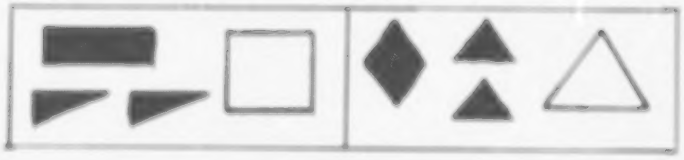
DRAWING

In each space, make a drawing of the object named there. Make the drawings large, as shown in the drawing of the door in the first space. Do not spend a lot of time on detail, but be sure that you draw the outline of the shape correctly.

SHAPE DISSECTION (PAPER FORM-BOARD)

Each of the spaces below encloses a number of small figures and also one large figure. The large figure on the right can be cut up to form the small figures on the left.

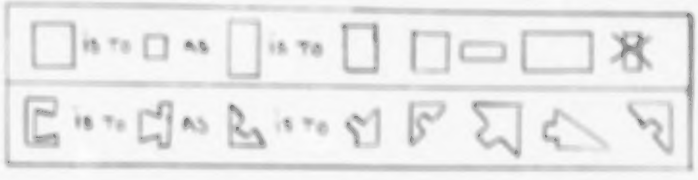
Draw lines on the large figure to show how it should be cut to form the smaller figures.



SPATIAL ANALOGIES

Look at the figures in the top row. 'Large square' is to 'small square' as 'large oblong' is to 'small oblong.' The small oblong has been crossed out because it bears the same relation to the large oblong as the small square does to the large square.

Cross out the correct figure in the second row in the same way.



APPENDIX 4

Test Administration

Original (after Eisner)

The administrator is asked to give these instructions in as natural and communicative fashion as is appropriate for the particular group and age level he is addressing. The actual manner in which drawing is initiated is not so important as the limitation of specific suggestion beyond that contained in the instructions.

> 'Today we are going to make some crayon drawings. I have up here, at the front of the room, crayons and paper that I will distribute to you in a few minutes.
>
> But before I give them to you, let's think about some of the ideas that you might use in your drawings. What I would like you to do is to make a drawing about the kinds of things that you do with your friends in the school yard before school, after school, or at recess. I would like you, right now, to think about the kind of things you do. What kind of games do you play in the school yard? How do you spend your time? What do you most like to do with your friends?' (The test administrator asks these questions but does not wait for an answer.)
>
> (The test administrator now distributes the material to the students but cautions them not to begin until they are told to do so.)
>
> 'I would like you to make a crayon drawing about the kinds of things that you do when you are with your friends in the school yard. You will have about 1/2 hour to complete your drawing. When you get the materials you may begin.' (If questions are asked by the subject they are to be answered in such a way as to get them into the act of drawing with the crayons. The point is that the students are to make drawings of group activities that they engage in after school or at recess.)

NOTE: If there is no school yard or children do not play there at any time, then the words, 'next to your house' should be substituted wherever reference to the school yard is made and 'at recess' will, of course, be omitted. If this substitution is made, it should be noted in the report.

Revised (Oakland)

INSTRUCTIONS TO STUDENTS:

"A woman who is an artist herself--and has four children of her own--has been collecting drawings from children and young people all over the world. She has pictures made by primitives in the Amazon jungle; by Eskimos in Greenland; by children in Bombay, India; Sao Paulo, Brazil; Hong Kong; Tokyo, Japan; Milan, Italy; Saarbruecken, Germany; Copenhagen, Denmark; Yaqui Indians of Arizona; and a number of other places. She would like to have some drawings from young people in California, too, and would appreciate it very much if each of you would make one for her collection.

"All the pictures are on the same subject; just draw a picture of yourself, and your friends, playing in the school yard or near your home."

INSTRUCTIONS TO TEACHERS:

Please do not give any other instructions, helps, or stimulation. If anyone asks if it is a test of any kind, only say that the woman is studying the way children draw, and hopes to write a book about what she finds out.

Tell them that you only have this one class period in which to complete the pictures.

If anyone makes a bad start and requests another piece of paper, give it to them if it is in keeping with your usual practice.

APPENDIX 5

List of All Available Tables for Each Country

1 Average age vs. art score

Gives total numbers, age distribution, average age and standard deviation for each art score.

(a) for total population

(b) for lower class only

(c) for middle class only

(d) for males only

(e) for females only

(f) Total number in each grade at each art score level

Also shows percentage of 0 and 1 on final art scores.

2 Class differences

Gives for each sex separately and grade the art score distributions of lower and middle class.

Gives total in each class.

Wilcoxon statistic computed for lower vs. middle class.

Hodges-Lehmann estimator for shift.

Mean art score and standard deviation for each social class.

t-statistic for difference of means.

Degrees of freedom of t-test in case this is used.

Also gives all of the above for both sexes combined for each grade considered.

3 Comparison of lower and middle class age distributions at each art score

Shows for each sex and each art score level 1A, 2A, . . . 7A, 1B, 2B, . . . 7B the age distribution of lower class vs. middle class.

Computes the Wilcoxon distribution for testing shifts between these distributions.

Also computes estimates of the shift and the t-statistic for testing differences between means.

Also does all of the above for both sexes combined.

4 A/B Style Comparisons

Shows for each class and sex the age distribution of A types vs. B types for scores 41, 43 and 5.

Gives total numbers in each group, Wilcoxon, t-statistics and estimates for shift.

Gives the above for both sexes combined for each class, classes combined for each sex, and total population.

5 Reading score comparisons

Only available for Italy, Hong Kong, India, Brazil, Japan, and U. S. A. (Cincinnati and Oakland).

(a) Shows for each sex and grade the distribution of art scores for poor, medium and good readers.

Computes the Wilcoxon test between poor and medium readers, medium and good readers, and between poor and good readers.

Gives estimates of shifts and computes maximin test for testing for ordered alternatives.

Gives total sample size for each of three groups (poor, medium and good readers) and also computes R, a measure of the efficiency of the maximin linear combination.

Gives all of the above for both sexes combined for each of the grades considered.

(b) Compares the age distributions for each sex and art score of poor, medium and good readers.

Gives the value of the Wilcoxon statistic for testing shift between the three pairs of distributions and also computes the maximin test for ordered alternatives.

Also computes the efficiency of the maximin procedure.

Gives total sample sizes for each group of readers.

Also does all of the above for each art score with both sexes combined.

Special tables available for Amazon Indians and Oakland

Amazon Indians: Distribution of art scores for three separate groups that are of varying distance from populated center.

Oakland: Tables as in 1 through 5 where split includes race as well as sex and social class.